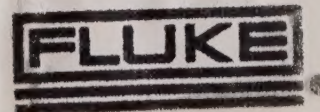


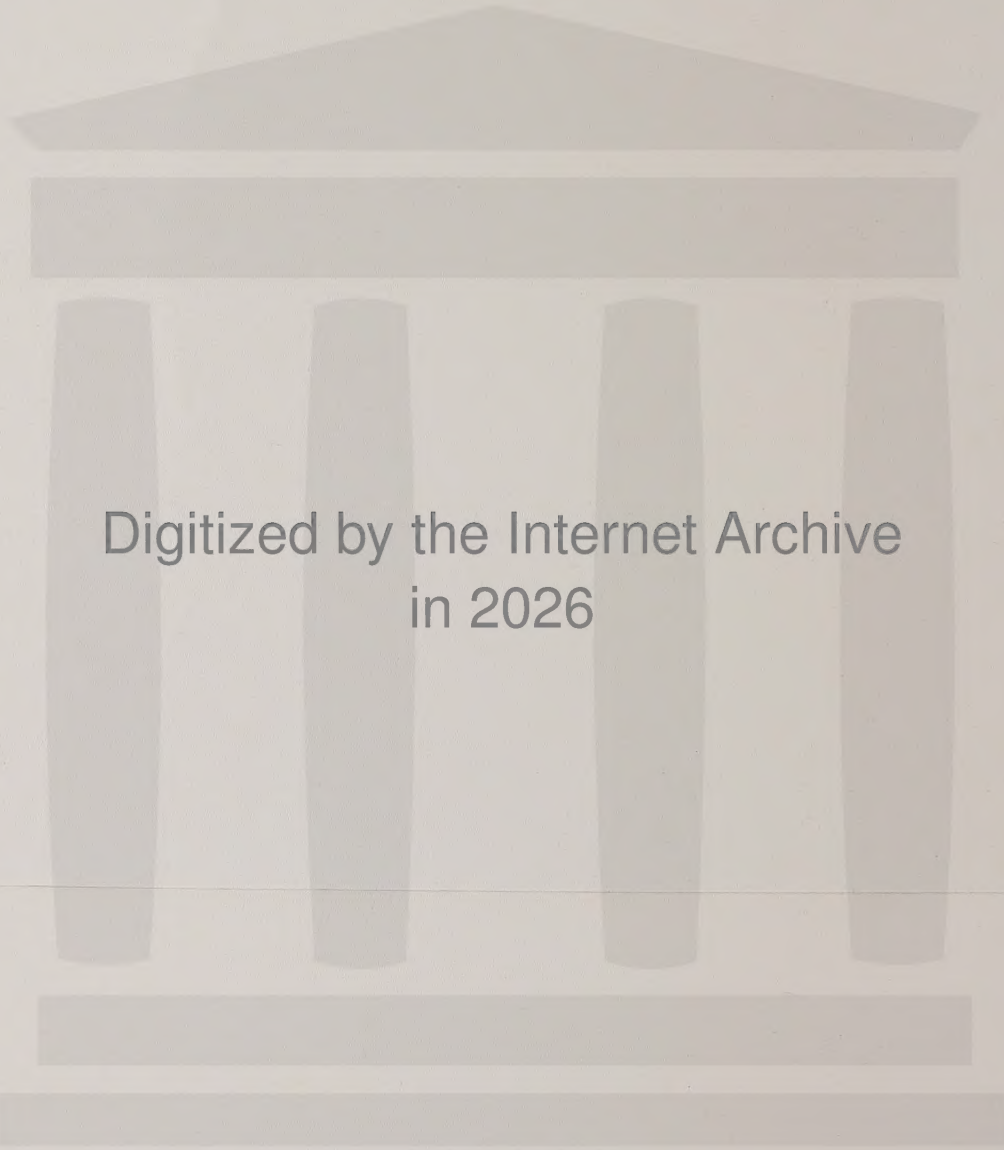
2240B

**Data
Logger**

Instruction Manual



P/N 469713
August 1977



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2240B

Data Logger

Instruction Manual

P/N 462945
July 1977



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*For European customers, Air Freight prepaid.

John Fluke Mfg. Co., Inc., P.O. Box 43210, Mountlake Terrace, Washington 98043

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Section 1

Introduction & Specifications

1-1. INTRODUCTION

1-2. The Fluke Model 2240B Data Logger, in its basic form, is a processor and recorder which is expandable, through the use of optional plug-in modules, into a user-designed data acquisition system capable of servicing up to 1000 channels of guarded analog data. The basic unit is contained within a mechanical housing and consists of a front-mounted control panel, a digital display, a digital printer, a power supply, the control logic required to interface the basic unit with a full complement of options, and a series of pcb and module slots designed to accommodate a number of plug-in options. To form an operational data acquisition system, the 2240B must be equipped with at least one each of the three following options: a scanner (Option —05 or —06), a scanner input connector (Option —07 or —08), and an A/D Converter (Option —09 or —10).

1-3. The front panel of the 2240B features all of the controls necessary to operate the unit with a full complement of optional plug-ins. The controls consist

primarily of push button switches which are separated into 10 unique groups. Five groups perform control functions and five groups are dedicated to programming the 2240B. The control group includes: Power, OUTPUT CONTROL, PROGRAM LIST, SCAN CONTROL and DISPLAY CONTROL. The Program groups include: TIME ENTRY, SCAN FORMAT, PROGRAMMING (CHANNEL and LIMITS), ADVANCE ADDRESS and DATA ENTRY.

1-4. The 2240B is energized, and all switches in the five control groups are enabled when the POWER switch is set to either POWER ON or KEYBOARD PROGRAM DISABLE. If channel programming data has been previously entered into memory (via the front panel programming switches), any one of four unique scan modes (single, interval, monitor or continuous) can be started and/or stopped using the SCAN CONTROL switches. During a scan sequence, analog data present at program-selected channels is measured and displayed at the 2240B front panel. When desired, this measurement data can also be recorded on either the internal printer and/or an external recording device. The recording devices to be used and the type of data to be recorded are

selected by the OUTPUT CONTROL and the SCAN CONTROL switch groups. While measurement data is being recorded, alternate forms of data (date and time or single channels) can be selected and displayed by depressing the appropriate switches in the DISPLAY CONTROL group. Similarly, an alternate form of data, program list, can be recorded when the SCAN CONTROL switches are reset and the internal printer is enabled. When the PROGRAM LIST switch is depressed under these conditions, the contents of the keyboard controlled program-memory is recorded on the internal printer. If a Remote Program Option (—17) is installed, a program list can be requested and output via the option (the internal printer will not respond).

1-5. The programming switch groups are enabled when the POWER switch is set to POWER ON. Program data is manually entered via the DATA ENTRY keyboard and the specific kind of data to be entered is determined by selecting it from either the TIME ENTRY, SCAN FORMAT or PROGRAMMING (CHANNEL, LIMITS) switch groups. Time is entered in days, hours, minutes and seconds, and is easily synchronized to the true time-of-day. The scan format can be randomly programmed to define: 6 digits of fixed data, first and last channel in a scan sequence, time interval between the start of scan sequences when the interval scan control mode is initiated, and the single channel to be monitored when the monitor scan control mode is initiated. Channel programming switches enable unique measurement functions and measurement limits to be assigned to each channel in the scan format. If one or more channels in the scan format are not to be used, a skip function can be programmed. Limits programming (Option —22) switches enable up to 30 unique 5-digit limit values (including HI/LO sense and polarity) to be programmed. Each limit is assigned a unique address code from 1 to 30, and any one of the limit values assigned to codes 1 through 15 and/or 16 or 30 can be assigned to any channel by entering the appropriate address codes while programming channel data.

1-6. The digital display is functionally two separate displays which are used for visually presenting the current measurement channel (three digits) and the current measurement data for that channel (polarity, plus five digits and a decimal point). During a normal scan sequence (first channel-to-last channel), the measurement channel is incrementally advanced as each channel measurement is completed, and continues to advance after each measurement until the last selected channel, (000 up to 999) is scanned. A series of annunciators complement the display and indicate the selected measurement function (volts, millivolts, temperature) for the channel indicated. The display is also used during the scan intervals to present the current date and time, and during programming sequences to display program data.

1-7. The printer employed in the 2240B is the Seiko Model 102. It is a medium-speed ink impression line printer capable of recording data at a maximum rate of 2.5 lines per second. Sixteen data columns are available. However, the print format for a scan sequence is fixed, as described in Section 2. Ordinary 2¼-inch fan-fold adding machine paper is used as the recording medium. A front-panel drawer is provided for both housing and take-up of the self-stacking fan-fold paper.

1-8. The power supply provided with the 2240B is capable of servicing both the basic unit and a full complement of options. Input power requirements are 100, 115 or 230V ac $\pm 10\%$, 50 or 60 Hz, 50 watts maximum. The desired combination of line voltage and frequency should be specified at the time of purchase.

1-9. The control logic of the 2240B includes all of the circuitry necessary to accommodate a full complement of 2240B options. Two important features of the control logic are: the program memory and the guard crossing. The program memory is impervious to the line power interruption and can be maintained for several years after the 2240B is switched OFF. The memory is sustained by a lithium battery which is switched into operation when the line power is removed. The guard-crossing circuit electrically isolates the operation of the scanner blocks (Option —05 or —06) and the analog portion of the measurement circuit (A/D Converter, Option —09 or —10) from the digital control and external equipment interface section of the 2240B.

1-10. Several options and accessories are available for use with the 2240B. The options, their quantity limitations and their installation requirements (factory or field) are listed in Table 1-1. Table 1-2 provides a description of the sub options included in —12, —13 and —14 series of options, and Table 1-3 describes the available 2240B accessories. Descriptions of the most commonly used options (—05, —06, —07, —08, —09, —10 and —11) and accessories (all except 2201A, 2202A and 2203A) are included in Section 6 of this manual. Descriptions of the other options and accessories are supplied separately (when the option or accessory is purchased) and most are designed as subsectional inserts for Section 6 of this manual. The 2201A, 2202A and 2203A series of scanner chassis are documented in separate stand-alone instruction manuals.

1-11. SPECIFICATIONS

1-12. Specifications for the Model 2240B Data Logger and its most-used options (i.e., Options —05, —06, —07, —08, —09, —10 and —11) are contained in Table 1-4 and 1-5, respectively. Specifications for other options are supplied in the appropriate option subsection in Section 6, Options and Accessories.

Table 1-1. 2240B Option Information

FUNCTION	OPTION #	DESCRIPTION	QUANTITY USED IN 2240B		FACTORY OR SERVICE CENTER INSTALLATION REQUIRED?
			Max	Min	
Input Connectors (10 channels each, at least one required per system)	--07	Solder Pin Connector	6	1	*No
	--08	Isothermal Block Connector			
	28	Current Transmitter, 1-5 mA			
	29	Current Transmitter, 0-20 mA			
	30	Current Transmitter, 10-50 mA			
Scanners (10 channels each, at least one required per system)	--05	General Purpose Scanner	6	1	*No
	--06	Low Level Scanner			
A-D Converters (one required per system)	--09	General Purpose A-D	1	1	Yes
	10	High Performance A-D			
Scaling and Linearization	--11	Temperature Measurement	1	0	Yes
	--25	Custom Scaling	1		
	26	Multiple Custom Scaling	1		
	--27	Engineering Units	4		
	--22	Alarm Set -- 15 Single Limits	2	0	Yes
	--23	Alarm Set Point Output	1	0	*No
Digital Input Digital Input/Output Digital Output (See Table 1-2)	--16	Digital Input Interface	3	0	*No
	--17	Remote Programming Interface			
	--12	ITTY RS-232C Interface			
	--13	Paper Punch Interface			
	14	Magnetic Tape Interface			

*Customer can install.

Table 1-2. Description of --12, --13 and --14 Series Options

OPTION NO.	DESCRIPTION	RECORDER TYPE	OPTION CONFIGURATION		
			Recorder	Cable	Interface PCB
12B	ASR33 Interface	Teleprinter	0	●	●
12C	TI733 KSR/RO Interface		0	●	●
--12L	RS-232C Data Terminal Interface		0	●	●
--12M	RS-232C/Modem Interface	Modem	0	●	●
13A	Facit 4070 (Bench Top) and Interface	Paper Tape Punch	●	●	●
13B	Facit 4070 (Rack Mounted) and Interface		●	●	●
13C	Facit 4070 Interface		0	●	●
13D	Facit 4203 0005 and Interface	Cassette	●	●	●
13E	Facit 4203 0005 Interface		0	●	●
14A	Kennedy 1600/5 and Interface	Magnetic Tape	●	●	●
14B	Kennedy 1610/5 and Interface		●	●	●
14C	Kennedy 1600/360 and Interface		●	●	●
14D	Kennedy 1610/360 and Interface		●	●	●
14E	Kennedy 1600/5 or 1610/5 Interface		0	●	●
14G	Kennedy 1600/360 or 1610/360 Interface		0	●	●

Table 1-3. 2240B Accessories

MODEL NO.	DESCRIPTION	FUNCTION
2201A	Scanner Chassis	Houses up to twelve —05 or —06 scanners. Operates up to 50-feet from 2240B.
2202A	Remote Scanner Chassis	Houses up to ten —05 or —06 scanners. Operates up to 1500-feet from 2240B.
2203A	RTD Scanner Chassis	Houses up to ten —04, —05 or —06 scanners. Operates up to 1500-feet from 2240B.
2200A-7007	Interface Connector, Blank (50-pin)	I/O connector for use with option —16 or —23.
2200A-7006	General Purpose Interface Cable (6-foot)	I/O connector and cable for use with option —16 or —23. (Connector on one end only.)
2200A-7005	Service Extender Cable Set	Extends most 2240B pcb's for servicing.
MO7-205-600	Rack Mounting Kit	Rack mounts 2240B in 19" wide console.
MOO-280-610	Rack Slide Kit, 24" Cabinet	Slide mounts 2240B in 19" (W) x 24" (D) console.
2010A-7013	Fan-Fold Printer Paper (1 dozen)	Replacement printer paper.
2010A-7014	Printer Ribbon (1 dozen)	Replacement printer ribbon.

Table 1-4. 2240B Specifications

OPERATIONAL

Channel Capacity 60 channels, expandable to 1000 channels using the Model 2201A, 2202A, and/or 2203A Scanner Chassis.

System Speed (Channels/sec) The table below gives scanning speeds for both 50 and 60 Hz systems. The numbers in parenthesis are for 50 Hz. System configuration is assumed to be 1000 channels with clock and fixed data header.

SCAN CONTROL MODE	A/D SPEED	ENABLED OUTPUT DEVICE									
		INTERNAL PRINTER		-12L, -12M, -14 (4800 BAUD)		-12 & TELETYPE (110 BAUD)		-13		-17 (4800 BAUD)	
		VOLTS	TEMP.	VOLTS	TEMP.	VOLTS	TEMP.	VOLTS	TEMP.	VOLTS	TEMP.
MONITOR	FAST	2.65	2.65	14.8 (12.3)	13.0 (12.1)	0.65	0.65	4.6	4.6	14.8 (12.3)	12.3 (11.5)
	SLOW	2.65 (2.46)	2.65 (2.32)	2.96 (2.46)	2.78 (2.32)	0.65	0.65	2.96 (2.46)	2.78 (2.32)	2.96 (2.46)	2.78 (2.32)
CONTINUOUS or INTERVAL	FAST	2.65	2.65	14.7 (12.3)	11.4 (11.0)	0.65	0.65	4.6	4.6	14.7 (12.3)	11.0 (10.7)
	SLOW	2.65 (2.46)	2.65 (2.23)	2.96 (2.46)	2.69 (2.23)	0.65	0.65	2.96 (2.46)	2.69 (2.23)	2.96 (2.46)	2.68 (2.23)

Channel Display 3 digits

Data Display

Numeric Polarity plus 5 digits

Annunciator mV, V, temperature, date and time

Table 1-4. 2240B Specifications (continued)

Scan Controls	Push button switches initiate the following scan sequences.										
	<table> <tr> <td>SINGLE</td><td>CONTINUOUS</td></tr> <tr> <td>INTERVAL</td><td>REMOTE</td></tr> <tr> <td>MONITOR</td><td>STOP/RESET</td></tr> </table>	SINGLE	CONTINUOUS	INTERVAL	REMOTE	MONITOR	STOP/RESET				
SINGLE	CONTINUOUS										
INTERVAL	REMOTE										
MONITOR	STOP/RESET										
Output Controls	Push button switches control the operation of the internal printer and/or external recorder.										
	<table> <tr> <td>PRINTER ENABLE</td><td>EXTERNAL ENABLE</td></tr> <tr> <td>ALL DATA</td><td>ALL DATA</td></tr> <tr> <td>ALARM DATA</td><td>ALARM DATA</td></tr> <tr> <td>INTERVAL DATA</td><td>INTERVAL DATA</td></tr> <tr> <td>PAPER ADVANCE</td><td></td></tr> </table>	PRINTER ENABLE	EXTERNAL ENABLE	ALL DATA	ALL DATA	ALARM DATA	ALARM DATA	INTERVAL DATA	INTERVAL DATA	PAPER ADVANCE	
PRINTER ENABLE	EXTERNAL ENABLE										
ALL DATA	ALL DATA										
ALARM DATA	ALARM DATA										
INTERVAL DATA	INTERVAL DATA										
PAPER ADVANCE											
Display Control	Push button switches select one of the following functions for display:										
	<table> <tr> <td>ALL CHANNELS</td><td>DATE AND TIME</td></tr> <tr> <td>SINGLE CHANNEL</td><td></td></tr> </table>	ALL CHANNELS	DATE AND TIME	SINGLE CHANNEL							
ALL CHANNELS	DATE AND TIME										
SINGLE CHANNEL											
Time Entry	Push button switches enable keyboard entry of 3-digit date (DAY) or time (HR, MIN, SEC). Clock operates from 50 or 60 Hz line frequency.										
Scan Format	Push button switches enable keyboard entry of following scan information:										
	<table> <tr> <td>FIXED DATA</td><td>INTERVAL-HR, MIN, SEC.</td></tr> <tr> <td>FIRST CHANNEL</td><td>MONITOR CHANNEL</td></tr> <tr> <td>LAST CHANNEL</td><td></td></tr> </table>	FIXED DATA	INTERVAL-HR, MIN, SEC.	FIRST CHANNEL	MONITOR CHANNEL	LAST CHANNEL					
FIXED DATA	INTERVAL-HR, MIN, SEC.										
FIRST CHANNEL	MONITOR CHANNEL										
LAST CHANNEL											
Program List	Push button switch enables the printer to record contents of program memory. This includes: channel number, range and function, limits address and limit values, fixed data, monitor channel, time of year, and interval.										
Programming	Push button switches enable keyboard entry of unique program data for each of the channels, this includes:										
	CHANNEL										
	Address..... 000-999										
	Function..... 40 mV, 400 mV, 4V, 40V, T1, T2, T3, T4 and Skip										
	Address Limit A... 1 through 15										
	Address Limit B... 16 through 30										
	LIMITS										
	Address..... 1 through 30										
	Sense..... High or Low										
	Polarity..... + or -										
	Value..... -39990 to +39990										
Advance Address	Push button switch for step advancing channel, alarm, monitor channel, or single channel addresses.										
Digital Printer											
Print Speed	2.5 lines/sec.										
Print Mechanism	Seiko Model 102										
Column Capacity	16										
Program Memory	Non-volatile with minimum life of 5 years (program data is retained while power is turned off).										
Options Required for Operation	One a/d converter (Option —09 or —10). At least one scanner pcb (Option —05 or —06). At least one input connector (Option —07 or —08).										

Table 1-4. 2240B Specifications (concluded)

GENERAL	
Dimensions	7 in. high X 17 in. wide X 22.47 in. deep (17.78 cm X 43.18 cm X 57 cm) See outline drawing in Figure 1-1.
Weight	Approximately 40 pounds without options (18.144 kg)
Power	Specify one of the following combinations at time of purchase: (50 watts maximum) 100V ac ±10%, 50 Hz 115/230V ac ±10%, 50 Hz 100V ac ±10%, 60 Hz 115/230V ac ±10%, 60 Hz
Warm-Up Time	One hour for full accuracy. Accuracy is reduced by 0.02% of range at time of the initial turn-on.
ENVIRONMENTAL	
Temperature	
Operating	0°C to +50°C
Storage	-40°C to +60°C
Humidity	80% relative humidity, non-condensing, 0 to +35°C 70% relative humidity, non-condensing, +35 to +50°C
Shock and Vibration	Meets MIL-T-28800A, Class 4

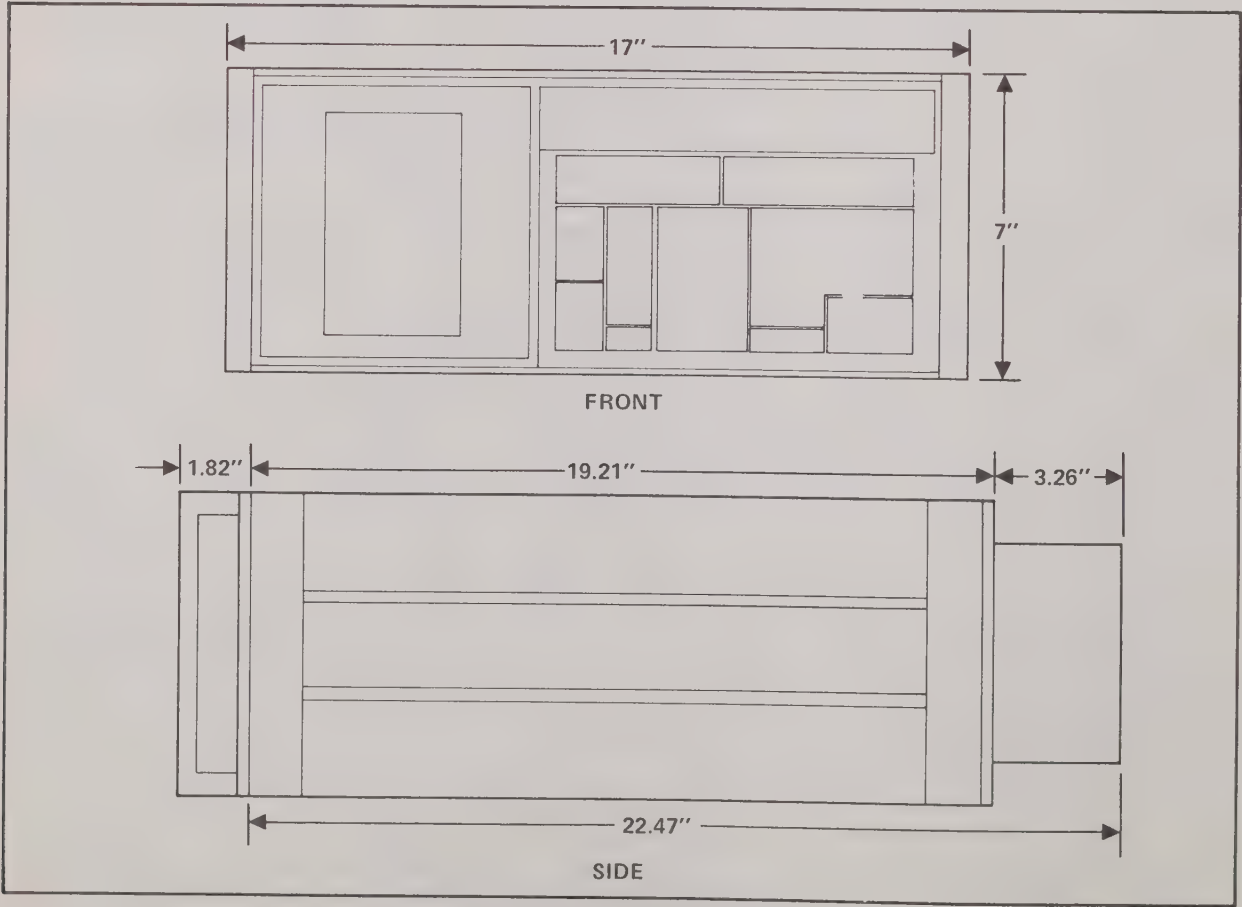


Figure 1-1. Outline Drawing

Table 1-5. Option Specifications (—05, —06, —07, —08, —09, —10, and —11, and —17)

OPTION —05**GENERAL PURPOSE SCANNER**

Channel Relay	10 low thermal-emf reed relays
Poles Per Channel	Two (form A)
Shield Switching	One switch for 10 channels
Voltage Offset	$\leq 10 \mu V$
Input Voltage Limit*	170V dc or peak ac maximum
Common Mode Voltage Limit	350V dc or peak ac maximum provided the Input Voltage Limit is not exceeded.
(Voltage between chassis and any input)	

*Maximum voltage between any two terminals in the system. Includes normal mode as well as common mode voltages.

OPTION —06**LOW LEVEL SCANNER**

Channel Relays	10 low thermal-emf reed relays
Poles per Channel	Three (includes shield switch)
Shield Switching	One switch per channel
Voltage Offset	$\leq 1 \mu V$
Input Voltage Limit*	170V dc or peak ac maximum
Common Mode Voltage Limits ...	350V dc or peak ac provided the input Voltage Limit is not exceeded.
(Voltage between chassis and any input)	
Over-Current Protection	470 Ω resistor in series with each input

*Maximum voltage between any two terminals in the system. Includes normal mode as well as common mode voltages.

OPTION —07**SOLDER PIN CONNECTOR**

Compatibility	Mates with either the —05 or —06 scanners
Terminal Style	Solder type
Number of Terminals	30 (High, Low, Shield per channel)

OPTION —08**ISOTHERMAL BLOCK CONNECTOR**

Compatibility	Mates with either the —05 or —06 scanners
Terminal Style	Screw type
Number of terminals	30 (High, Low, Shield per channel)
Temperature Gradient between ..	$\pm 0.05^\circ C$ maximum
any terminals	
Reference Junction Stability	$\pm 0.005^\circ C$ per $^\circ$ ($0^\circ C$ to $50^\circ C$)

OPTION —09**GENERAL PURPOSE****A/D CONVERTER**

Compatibility	Specifications apply when used with the General Purpose Scanner (Option —05)
Measurement Method	Dual slope integration over 5 line cycles
Measurement Speed	3 readings per sec with integration over 5 line cycles
Dynamic Range	40,000 counts (0-39,999)

Table 1-5. Option Specifications (continued)

Ranges	±400 mV (10 μ V resolution) ±4V (100 μ V resolution)
Input Impedance	The a/d converter uses a single-pole R-C input filter. Its input impedance is initially 39k Ω , and increases to $\geq 200\text{M}\Omega$ when the filter is settled (fully charged). Since settling time is not an operator controlled function, the source impedance of the circuit being measured must be $< 4\text{k}\Omega$ to achieve the full 200M Ω input impedance, and thus, avoid filter settling errors. See Figure 1. Refer to the a/d converter theory of operation for additional details.
Zero Stability	Automatic zero
Overload without Damage	170V dc or peak ac any range
Overrange Indication	Front panel display, printer and output indicate overrange
Common Mode Rejection	140 dB at 50 and 60 Hz $\pm 0.1\%$, 120 dB at dc with 1 k Ω unbalance
Common Mode Voltage	Maximum of 350V dc or peak ac
Normal Mode Rejection	70 dB at 50 and 60 Hz $\pm 0.1\%$
Accuracy (System*)	
90 Days (20°C to 30°C)	$\pm(0.02\%$ reading $+0.005\%$ range $+10\ \mu\text{V})$
1 Year (15°C to 35°C)	$\pm(0.03\%$ reading $+0.01\%$ range)
Temperature Coefficient	$\pm(0.002\%$ reading $+0.001\%$ range)/°C (0°C to 20°C and 30°C to 50°C)

*System accuracy includes all instrument errors such as a-d errors, scalar errors, power supply, internal warm-up, etc.

OPTION —10

HIGH PERFORMANCE A/D CONVERTER

Compatibility	Specifications apply when used with the Low Level Scanner (Option —06)	
Measurement Method	Dual slope integration over 5 line cycles (slow speed) or 1 line cycle (fast speed)	
Measurement Speed	3 readings per sec with integration over 5 line cycles (slow speed) 15 readings per sec with integration over 1 line cycle (fast speed) Selectable by internal switch	
Dynamic Range	40,000 counts (0-39,999)	
Ranges	±40 mV (1 μ V resolution) ±400 mV (10 μ V resolution)	±4V (100 μ V resolution) ±40V (1 mV resolution)
Input Impedance	$> 200\text{M}\Omega$ on all ranges except 40V range; input impedance is 10M Ω on 40V range. The a/d converter uses a single-pole R-C input filter. Its input impedance is initially 39k Ω , and increases to $\geq 200\text{M}\Omega$ when the filter is settled (fully charged). Since settling time is not an operator controlled function, the source impedance of the circuit being measured must be $< 4\text{k}\Omega$ to achieve the full 200M Ω input impedance, and thus, avoid filter settling errors. See Figure 1. Refer to the a/d converter theory of operation for additional details.	
Zero Stability	Automatic zero	
Overload without Damage	170V dc or peak ac any range	
Overrange Indication	Front panel display, printer and output indicate overrange	

Table 1-5. Option Specifications (continued)

Common Mode Rejection	140 dB at 50 and 60 Hz $\pm 0.1\%$, 120 dB at dc with 1 k Ω unbalance at slow speed. 110 dB at 50 and 60 Hz $\pm 0.1\%$, 120 dB at dc with 1 k Ω unbalance at fast speed.
Common Mode Voltage	Maximum of 350V dc or peak ac
Normal Mode Rejection	70 dB at 50 and 60 Hz $\pm 0.1\%$ slow speed 55 dB at 50 and 60 Hz $\pm 0.1\%$ fast speed
Accuracy (System *)	
90 Days (20°C to 30°C)	$\pm(0.01\%$ reading $+0.005\%$ range $+3 \mu\text{V}$) slow speed $\pm(0.01\%$ readings $+0.008\%$ range $+5 \mu\text{V}$) fast speed
1 Year (15°C to 35°C)	$\pm(0.02\%$ readings $+0.01\%$ range $+5 \mu\text{V}$) slow speed $\pm(0.02\%$ readings $+0.015\%$ range $+7 \mu\text{V}$) fast speed
Temperature Coefficient	$\pm(0.001\%$ readings $+0.001\%$ range)/°C
(0°C to 20°C and 30°C to 50°C)	
Reference Voltage for	Available via 2 jacks at the rear of instrument.
Self Check	These voltages can be used for initial checkout by wiring to scanner inputs for system self check.
Reference Voltages	2V, 0.02V
Reference Accuracy	90 days, 20°C—30°C $\pm 0.02\%$
Reference Stability	$\pm 0.003\%/^{\circ}\text{C}$ $\pm 0.003\%/yr$

*System accuracy includes all instrument errors such as a-d errors, scanner errors, power supply, internal warm-up, etc.

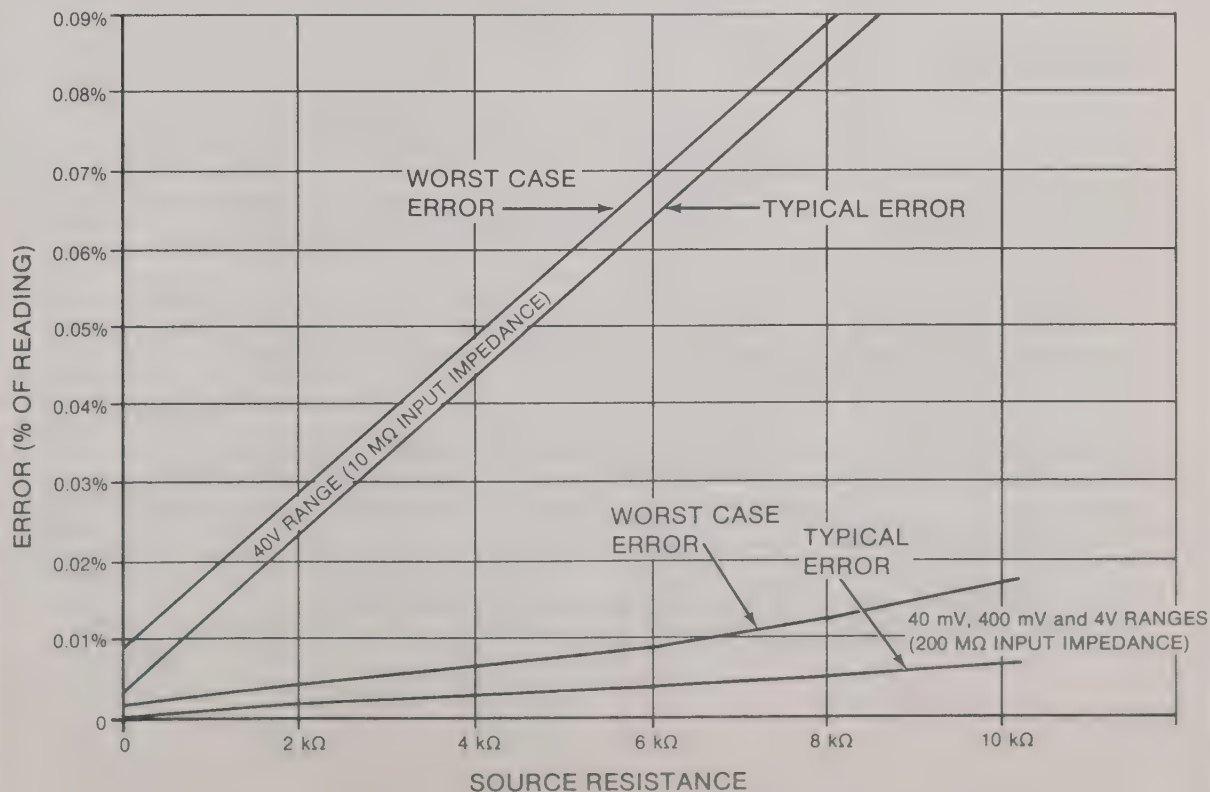


Figure 1. Error (% of Reading) versus Source Resistance

Table 1-5. Option Specifications (continued)

OPTION —11
TEMPERATURE AND SCALING
OPTION

Compatible Probe Types	J, K, T, R, S, E, B, C, G, D, (W3), RTD (385 platinum), RTD (392 platinum), and current transmitter (1-5 mA, 4-20 mA, and 10 to 50 mA) reading 0 to 100%. RTD's require a 2203A with at least one —03 Option (connector) and one —04 Option (scanner). Connector —28, —29 or —30 required with current transmitter.	
Linearization	Digital, 31 to 33 optimized segment lengths.	
Open Circuit Detection	Source impedance of greater than 7.5k $\pm$ 2.5 k Ω and capacitance $\leq$ 0.01 μ F is defined as an open circuit.	
Open Circuit Indication	Front panel display, printer and all serial output devices provide open circuit indications.	
Temperature Scale Selection	Switch is provided on the inside of the 2240A for selecting either the $^{\circ}$ C or $^{\circ}$ F temperature scale for measurement, display and recording purposes.	
Reference Junction Compensation	Automatic from 0 $^{\circ}$ to +50 $^{\circ}$ C. (Less than $\pm$ 0.05 $^{\circ}$ error from 15 to 35 $^{\circ}$ C for J, K, and T type thermocouples.)	
Resolution Linearization	Temperature resolution system specifications of either 1 $^{\circ}$ or 0.1 $^{\circ}$ apply when the following options are used:	
	0.1 $^{\circ}$	1.0 $^{\circ}$
A/D Converter, Option	—10	—09
Scanner, Option	—06	—05
Input Connector, Option	—08	—08
System Specification	0.1 $^{\circ}$	1.0 $^{\circ}$
Resolution		
Accuracy	See Table 1	See Table 2
Conformity to NBS Table		
Temperature Coefficient	$\pm$ (0.0015% of reading +0.01 $^{\circ}$)/ $^{\circ}$ C (0 to 20 $^{\circ}$ C and 30 to 50 $^{\circ}$ C)	

Table 1-5. Option Specifications (concluded)

Table 1. System Accuracy, 0.1° Resolution
(using Low Level Scanner and High Performance
A-D Converter)

Temperature Range Per Thermocouple Type	Worst Case Reso- lution	NBS Con- formity	System Accuracy(±)			
			90 Days 77°F ±9°F 25°C ±5°C		1 Year 77°F ±18°F 25°C ±10°C	
			Slow	*Fast	**Slow	
J Iron-Constantan						
*F -332 to -200	0.2°	0.15°	1.0°	1.2°	1.2°	
-200 to 32	0.1°	0.15°	0.8°	0.9°	1.0°	
32 to 1400	0.1°	0.1°	0.8°	0.7°	0.7°	
1400 to 2200	0.1°	0.3°	0.8°	0.9°	1.0°	
*C -202 to 0	0.1°	0.083°	0.6°	0.7°	0.7°	
0 to 760	0.1°	0.055°	0.4°	0.5°	0.5°	
760 to 1205	0.1°	0.166°	0.5°	0.6°	0.6°	
K Chromel-Alumel						
*F -332 to -300	0.3°	0.175°	1.2°	1.4°	1.5°	
-300 to -200	0.2°	0.175°	1.0°	1.2°	1.3°	
-200 to 32	0.2°	0.175°	0.8°	1.0°	1.1°	
32 to 500	0.1°	0.15°	0.7°	0.8°	0.8°	
500 to 2500	0.1°	0.15°	0.8°	0.9°	1.0°	
*C -202 to -172	0.2°	0.1°	0.7°	0.8°	0.9°	
-172 to -130	0.1°	0.1°	0.6°	0.7°	0.8°	
-130 to 0	0.1°	0.1°	0.5°	0.6°	0.6°	
0 to 260	0.1°	0.083°	0.4°	0.5°	0.5°	
260 to 1370	0.1°	0.083°	0.5°	0.6°	0.6°	
T Copper-Constantan						
*F -332 to -300	0.2°	0.1°	1.0°	1.4°	1.5°	
-300 to -200	0.1°	0.1°	0.9°	1.2°	1.3°	
-200 to 32	0.1°	0.1°	0.8°	1.0°	1.1°	
32 to 750	0.1°	0.1°	0.6°	0.7°	0.8°	
*C -202 to -130	0.1°	0.055°	0.6°	0.8°	0.8°	
-130 to 0	0.1°	0.055°	0.5°	0.6°	0.7°	
0 to 400	0.1°	0.055°	0.4°	0.5°	0.5°	
E Chromel-Constantan						
*F -332 to -240	0.2°	0.175°	0.9°	1.0°	1.1°	
-240 to 32	0.1°	0.175°	0.8°	0.9°	1.0°	
32 to 500	0.1°	0.11°	0.6°	0.7°	0.7°	
500 to 1830	0.1°	0.11°	0.6°	0.7°	0.7°	
*C -202 to 0	0.1°	0.1°	0.5°	0.6°	0.6°	
0 to 260	0.1°	0.1°	0.4°	0.5°	0.5°	
260 to 960	0.1°	0.07°	0.4°	0.5°	0.5°	
R Pt. 13% Rhodium						
*F 32 to 90	0.4°	0.2°	2.8°	3.6°	3.6°	
90 to 500	0.3°	0.2°	2.4°	3.2°	3.2°	
500 to 3200	0.2°	0.2°	1.6°	2.2°	2.4°	
*C 0 to 260	0.2°	0.1°	1.5°	2.2°	2.2°	
260 to 350	0.2°	0.1°	1.0°	1.2°	1.4°	
350 to 1760	0.1°	0.1°	1.0°	1.4°	1.4°	
S Pt. 10% Rhodium						
*F 32 to 90	0.4°	0.2°	2.8°	3.6°	3.6°	
90 to 500	0.3°	0.2°	2.4°	3.2°	3.2°	
500 to 3200	0.2°	0.2°	1.6°	2.2°	2.4°	
*C 0 to 260	0.2°	0.1°	1.5°	2.2°	2.2°	
260 to 550	0.2°	0.1°	1.0°	1.2°	1.4°	
550 to 1760	0.1°	0.1°	1.0°	1.4°	1.4°	
B Pt. 6% Rhodium versus Pt. 30% Rhodium						
*F 896 to 1800	0.3°	0.14°	2.6°	3.6°	3.6°	
1800 to 3308	0.2°	0.14°	2.0°	2.6°	2.6°	
*C 480 to 1000	0.2°	0.08°	1.6°	2.4°	2.4°	
1000 to 1820	0.1°	0.08°	1.2°	1.6°	1.6°	
C* Tungsten 5% Rhenium versus Tungsten 26% Rhenium						
*F 32 to 3632	0.2°	0.18°	1.2°	1.6°	1.6°	
3632 to 4208	0.2°	13.5°	15.0°	16.0°	16.0°	
*C 0 to 2000	0.1°	0.1°	0.7°	1.0°	1.0°	
2000 to 2320	0.1°	7.5°	9.0°	9.5°	9.5°	
D* (W3)* Tungsten 3% Rhenium versus Tungsten 25% Rhenium						
*F 32 to 500	0.2°	0.22°	1.4°	1.8°	1.8°	
500 to 3632	0.2°	0.22°	1.2°	1.6°	1.6°	
3632 to 4208	0.2°	18.4°	20.0°	21.0°	21.0°	
*C 0 to 260	0.1°	0.12°	0.8°	1.0°	1.0°	
260 to 2000	0.1°	0.12°	0.7°	1.0°	1.0°	
2000 to 2320	0.1°	10.2°	12.0°	12.5°	12.5°	
G* Tungsten versus Tungsten 26% Rhenium						
*F 410 to 800	0.2°	0.2°	1.6°	2.2°	2.2°	
800 to 3632	0.2°	0.2°	1.4°	1.8°	1.8°	
3632 to 4208	0.2°	13.8°	15.0°	16.0°	16.0°	
*C 210 to 420	0.2°	0.12°	1.0°	1.4°	1.4°	
420 to 2000	0.1°	0.12°	0.8°	1.0°	1.2°	
2000 to 2320	0.1°	7.1°	8.0°	8.5°	8.5°	

*Not ANSI Symbol

**Slow Speed -2.5 readings/sec

***Fast Speed -15 readings/sec

Table 2. System Accuracy, 1.0° Resolution (using
General Purpose Scanner and General Purpose
A-D Converter)

Temperature Range Per Thermocouple Type	Worst Case Reso- lution	NBS Con- formity	System Accuracy (±)			
			90 Days 77°F ±9°F 25°C ±5°C		1 Year 77°F ±18°F 25°C ±10°C	
			**Slow		**Slow	
J Iron-Constantan						
*F -332 to 32	1°	0.15°	3°		4°	
32 to 1400	1°	0.1°	2°		3°	
1400 to 2200	1°	0.3°	2°		3°	
*C -202 to 0	1°	0.083°	2°		3°	
0 to 760	1°	0.055°	2°		2°	
760 to 1205	1°	0.166°	2°		2°	
K Chromel-Alumel						
*F -332 to -200	1°	0.175°	3°		4°	
-200 to 32	1°	0.175°	3°		4°	
32 to 500	1°	0.15°	2°		3°	
500 to 2500	1°	0.15°	2°		3°	
*C -202 to -130	1°	0.1°	2°		3°	
-130 to 0	1°	0.1°	2°		2°	
0 to 260	1°	0.083°	2°		2°	
260 to 1370	1°	0.083°	2°		2°	
T Copper-Constantan						
*F -332 to -200	1°	0.1°	3°		4°	
-200 to 32	1°	0.1°	2°		3°	
32 to 750	1°	0.1°	2°		3°	
*C -202 to -130	1°	0.055°	2°		3°	
-130 to 32	1°	0.055°	2°		3°	
0 to 400	1°	0.055°	2°		2°	
E Chromel-Constantan						
*F -332 to 32	1°	0.175°	3°		4°	
32 to 500	1°	0.11°	2°		3°	
500 to 1830	1°	0.11°	2°		3°	
*C -202 to 0	1°	0.1°	2°		3°	
0 to 260	1°	0.1°	2°		2°	
260 to 960	1°	0.1°	2°		2°	
R Pt. -13% Rhodium						
*F 0 to 500	4°	0.2°	10°		12°	
500 to 3200	2°	0.2°	7°		9°	
*C -18 to 260	2°	0.1°	6°		8°	
260 to 1760	1°	0.1°	4°		6°	
S Pt. -10% Rhodium						
*F 0 to 500	4°	0.2°	10°		12°	
500 to 3200	2°	0.2°	7°		9°	
*C -18 to 260	2°	0.1°	6°		8°	
260 to 1760	1°	0.1°	4°		6°	
B Pt. 6% Rhodium versus Pt. 30% Rhodium						
*F 896 to 1800	3°	0.14°	10°		12°	
1800 to 3308	2°	0.14°	8°		10°	
*C 480 to 100	2°	0.08°	6°		8°	
1000 to 1820	2°	0.08°	5°		6°	
C* Tungsten 5% Rhenium versus Tungsten 26% Rhenium						
*F 32 to 3632	2°	0.18°	4°		5°	
3632 to 4208	2°	13.5°	18°		20°	
*C 0 to 200	1°	0.1°	3°		3°	
2000 to 2320	1°	7.5°	10°		11°	
D* (W3)* Tungsten 3% Rhenium versus Tungsten 25% Rhenium						
*F 32 to 3632	2°	0.22°	4°		5°	
3632 to 4208	2°	10.2°	14°		15°	
*C 0 to 2000	1°	0.12°	3°		3°	
2000 to 2320	1°	10.2°	14°		15°	
G* Tungsten versus Tungsten 26% Rhenium						
*F 410 to 800	2°	0.2°	6°		7°	
800 to 3632	2°	0.2°	4°		5°	
3632 to 4208	2°	13.8°	18°		19°	
*C 210 to 420	2°	0.12°	4°		4°	
420 to 2000	1°	0.12°	3°		3°	
2000 to 2320	1°	7.1°	10°		11°	

*Not ANSI Symbol

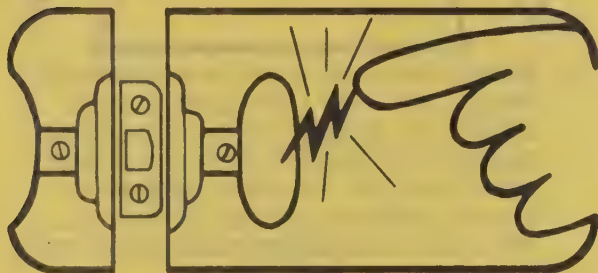
**Slow Speed ≈2.5 readings/sec



static awareness



A Message From
John Fluke Mfg. Co., Inc.



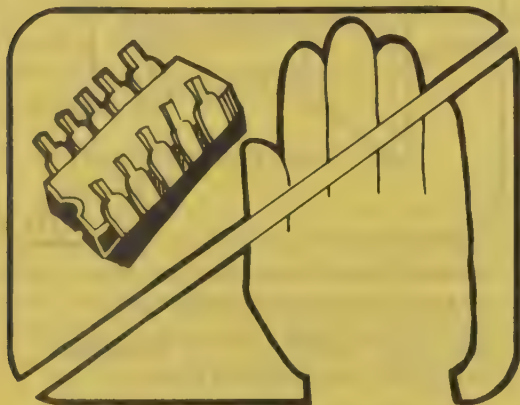
Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

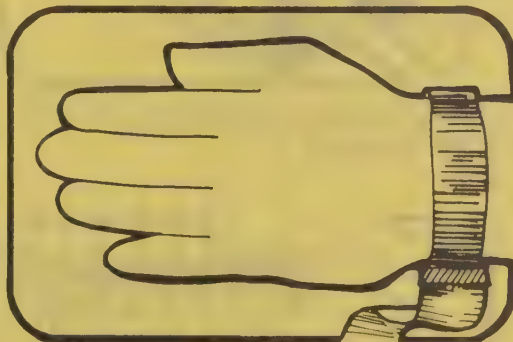
The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol



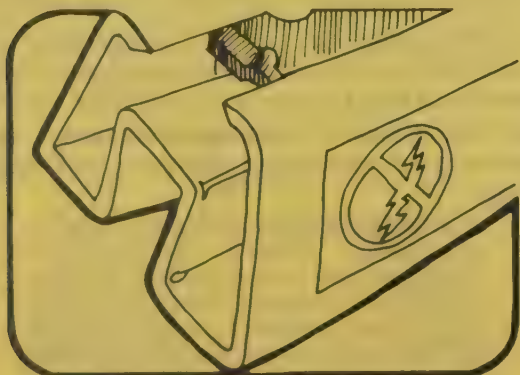
The following practices should be followed to minimize damage to S.S. devices.



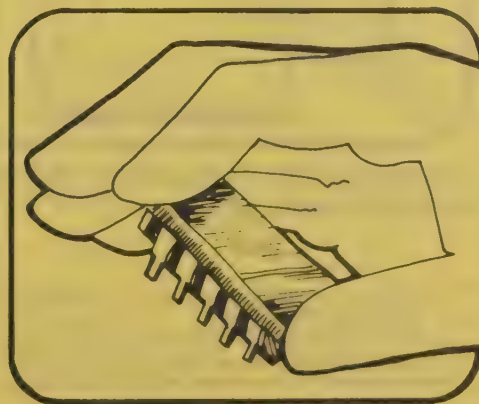
1. MINIMIZE HANDLING



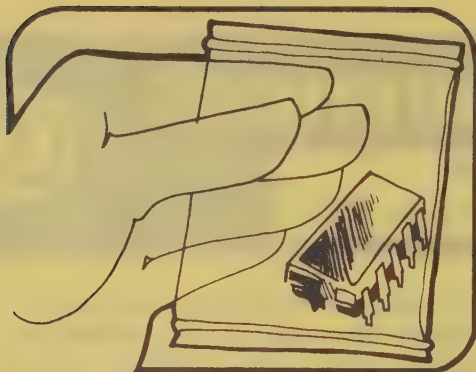
3. DISCHARGE PERSONAL STATIC
BEFORE HANDLING DEVICES



2. KEEP PARTS IN ORIGINAL CONTAINERS
UNTIL READY FOR USE.



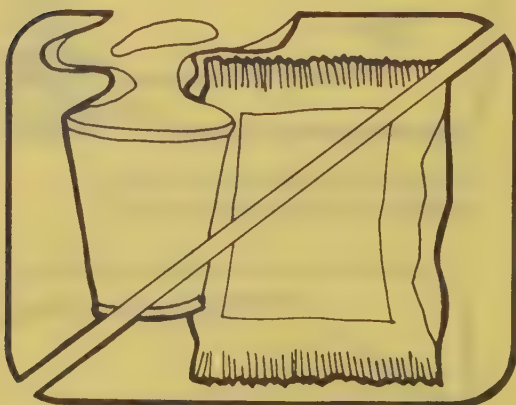
4. HANDLE S.S. DEVICES BY THE BODY



5. USE ANTI-STATIC CONTAINERS FOR HANDLING AND TRANSPORT

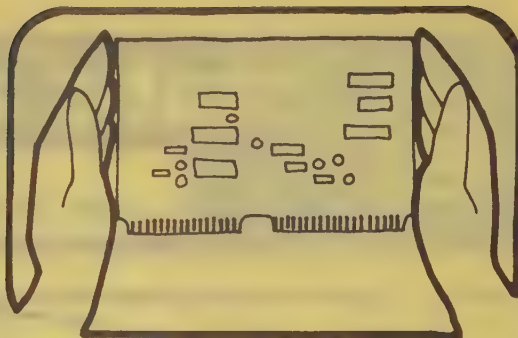


6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE

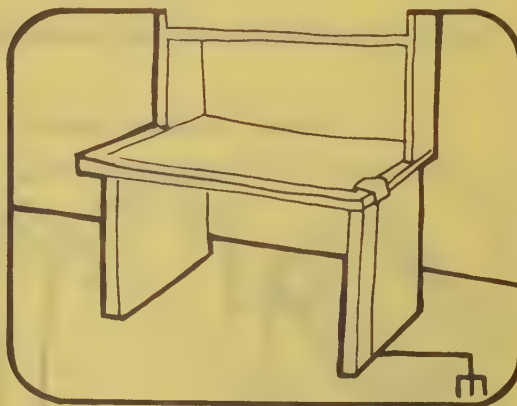


7. AVOID PLASTIC, VINYL AND STYROFOAM® IN WORK AREA

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AND GENERAL DYNAMICS, POMONA DIV.



8. WHEN REMOVING PLUG-IN ASSEMBLIES, HANDLE ONLY BY NON-CONDUCTIVE EDGES AND NEVER TOUCH OPEN EDGE CONNECTOR EXCEPT AT STATIC-FREE WORK STATION. PLACING SHORTING STRIPS ON EDGE CONNECTOR USUALLY PROVIDES COMPLETE PROTECTION TO INSTALLED SS DEVICES.



9. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION
10. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.
11. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

Anti-static bags, for storing S.S. devices or pcbs with these devices on them, can be ordered from the John Fluke Mfg. Co., Inc.. See section 5 in any Fluke technical manual for ordering instructions. Use the following part numbers when ordering these special bags.

John Fluke Part No.	Description
453522	6" X 8" Bag
453530	8" X 12" Bag
453548	16" X 24" Bag
454025	12" X 15" Bag
Pink Poly Sheet	Wrist Strap
30"x60"x60 Mil	P/N TL6-60
P/N RC-AS-1200	\$7.00
\$20.00	

Section 2

Operating Instructions

2-1. INTRODUCTION

2-2. This section of the manual contains information concerning the installation and operation of the Model 2240B Data Logger. It is recommended that the contents of this section be read and understood before any attempt is made to operate the instrument. Should any difficulties arise during operation, contact your nearest John Fluke Sales Representative, or the John Fluke Mfg. Co., Inc., P.O. Box 43210, Mountlake Terrace, WA, 98043, Telephone (206) 774-2211. A list of sales representatives is given in Section 7.

2-3. SHIPPING INFORMATION

2-4. The 2240B is packaged and shipped in a foam-packed container. Upon receipt of the instrument, a thorough inspection should be made to reveal any possible shipping damage. Special instructions for inspection and claims are included in the shipping carton.

2-5. If reshipment of the instrument is necessary, the original container should be used. If the original container is not available, a new container can be obtained from the John Fluke Mfg. Co., Inc. Please reference the instrument's model number when requesting a new shipping container.

2-6. INPUT POWER

WARNING

LETHAL VOLTAGES MAY BE PRESENT AT THE LINE POWER INPUT CONNECTOR AND THE POWER SUPPLY PCB ASSEMBLY WHEN THE 2240B IS CONNECTED TO LINE POWER. LETHAL COMMON MODE VOLTAGES MAY ALSO BE PRESENT AT THE SCANNER INPUT CONNECTORS AND SCANNER PCB'S EVEN THOUGH THE LINE POWER CORD IS DISCONNECTED.

2-7. The 2240B can be operated from either 100, 115, or 230V ac, 50 or 60 Hz line power depending upon the combination specified at the time of purchase. Before connecting the unit to line power, check and, if necessary, set the line-voltage and the line-frequency switches.

- Remove the top dust cover from the instrument.
- Locate the line-voltage switch shown in Figure 2-1.

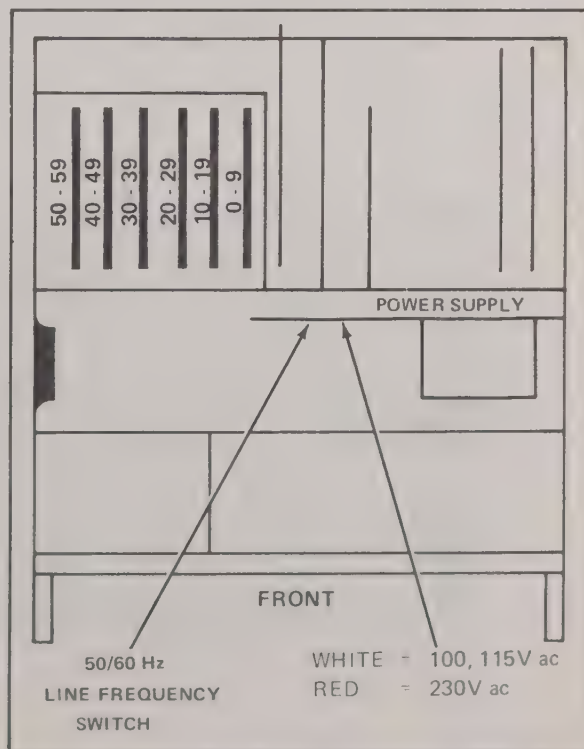


Figure 2-1. Power Supply Voltage and Frequency Switches

- c. Refer to the rear panel decal and use a screwdriver to set the slide switch so that the specified voltage (100/115 (white) or 230V ac (red)) appears in the slide aperture.
- d. Locate the line frequency switch shown in Figure 2-1.
- e. Set the switch to the line frequency (50 or 60 Hz) specified on the rear panel decal.

NOTE

If it becomes necessary to change the line frequency from that originally specified, a crystal on the guard crossing must be changed. Contact your nearest John Fluke Representative or the John Fluke Mfg. Co., Inc.

- f. Install the proper fuse in the rear-panel fuse holder.
 - 100V ac — 3/4A Slo-Blo
 - 115V ac — 3/4A Slo-Blo
 - 230V ac — 3/8A Slo-Blo
- g. Re-install the top dust cover.

2-8. RACK INSTALLATION

- 2-9. The 2240B is designed for either bench-top use or for installation in a standard 19-inch equipment rack

using the accessory Rack Mounting Kit (John Fluke P/N MO7-205-600). Chassis slides (John Fluke P/N MOO-208-610) can also be installed to facilitate access to the instrument when it is installed in an equipment rack. Information regarding the installation of the rack-mounting accessories is included in Section 6.

2-10. OPERATING FEATURES

- 2-11. The function and location of all 2240B controls and indicators are shown in Figure 2-2 and described in Table 2-1.

2-12. OPERATING NOTES

- 2-13. The following paragraphs describe various conditions which should be considered before operating the 2240B.

2-14. AC Line Connection

- 2-15. The rear-panel, three-prong, U-ground connector permits the 2240B to be connected, through a power cord, to either 100, 115 or 230V ac, 50 or 60 Hz line power. The offset prong on this connector is connected to the 2240B chassis and should be connected, via the power cord, to a high quality earth ground.

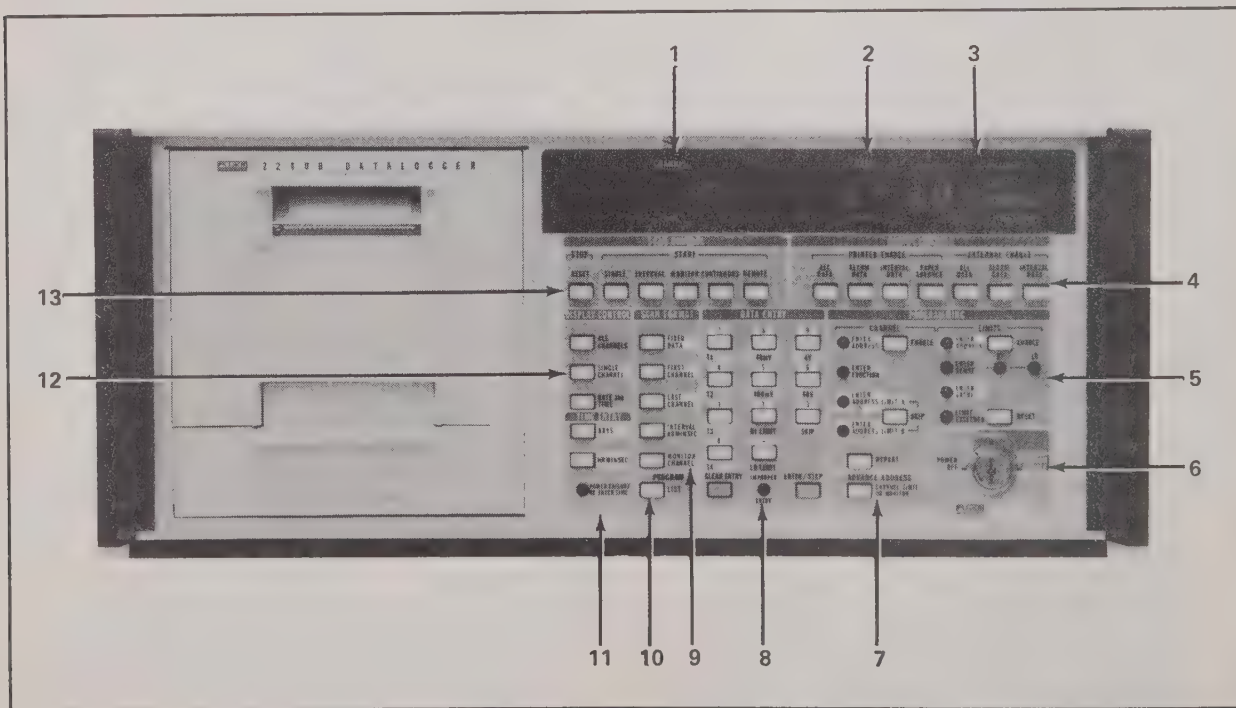


Figure 2-2. 2240B Front Panel Controls and Indicators

Table 2-1. 2240B Front Panel Controls and Indicators

REF. NO.	NAME	FUNCTION
1	CHANNEL/DAY Display	A three digit multi-purpose display which provides a read-out of any one of the following: CHANNEL, DAY or limits address. Channel data is displayed as a three digit number from 000 to 999. Day data is displayed as a three-digit date code from 000 to 999, and can be distinguished from Channel data by a lit DATE AND TIME lamp in the display annunciator group. Limits address data is displayed as a two-digit code from 01 to 30. The left-most digit is blanked to distinguish it from both Channel and Day data.
2	DATA/HR:MIN:SEC Display	A six digit display which provides a read-out of any one of the following: measurement data (voltage, temperature, etc.); time-of-day in hours, minutes and seconds; programmed function; or programmed limit value.
3	Display Annunciator	Four LED's which light on a mutually-exclusive basis to indicate the kind of data currently present on the CHANNEL/DATA display. MILLIVOLTS, VOLTS, and TEMPERATURE indicate the measurement function assigned to the displayed channel. DATE AND TIME indicates that the display is assigned to read the time-of-year (day, hours, minutes, seconds).
4	OUTPUT CONTROL Switches	Seven push button switches that are divided into two groups (EXTERNAL ENABLE and PRINTER ENABLE) to provide individual control over the type of data to be recorded by the printer and any external recording peripherals. Three switches in each group allow selection of either ALL DATA, ALARM DATA, or INTERVAL DATA. A fourth switch (PAPER ADVANCE) in the PRINTER ENABLE group allows the printer paper to be manually advanced.
5	PROGRAMMING Switches	Two groups of push button switches (CHANNEL and LIMITS) that allow function (voltage, temperature or skip) and limit data to be assigned to each channel. Data is assigned via the DATA ENTRY keyboard, and a program sequence for either channel or limits data is initiated by depressing the ENABLE switch in the appropriate group. A lamp is lit to prompt the entry of the necessary data. Each data entry is completed and the sequence is advanced by pressing the ENTER/STEP switch in the DATA ENTRY switch group.
6	Power Switch	A three-position key-operated switch used to switch the 2240B on or off. In both the POWER-ON and KEYBOARD PROGRAM DISABLE position, the data logger is energized and operational. However, program data can only be entered when the switch is in the POWER ON position. Removing the key in the KEYBOARD PROGRAM DISABLE position prevents tampering with, or accidental destruction of, program data.

Table 2-1. 2240B Front Panel Controls and Indicators (continued)

REF. NO.	NAME	FUNCTION
7	ADVANCE ADDRESS Switch	A push button switch which allows the displayed channel or limits address to be sequentially advanced for programming purposes. Also advances the monitor channel address (when the monitor mode is selected) to allow the manual scanning of channels and the single channel address
8	DATA ENTRY Keyboard	A general purpose push button keyboard for entering variable magnitude and function program data. The keyboard operates in conjunction with the TIME ENTRY, SCAN FORMAT, and PROGRAMMING switch groups. CLEAR ENTRY and ENTER/STEP switches are also provided. An IMPROPER ENTRY lamp lights to indicate that an attempt to enter illegal data has been made.
9	SCAN FORMAT Switches	A series of push button switches that allow the format of a scan sequence to be programmed via the DATA ENTRY keyboard. This includes a fixed data heading, first and last channels, and the time interval between the start of scan cycles when operating in the interval scan control mode. When operating the monitor scan control mode, the MONITOR CHANNEL switch allows the monitored channel to be assigned via the data entry keyboard.
10	PROGRAM LIST Switch	A push button switch which enables the operator to solicit a printout of all limits data and the First-Channel through Last-Channel data in program memory. Prior to pressing the PROGRAM LIST switch, both the RESET switch in the SCAN CONTROL switch group and the ALL DATA switch in the PRINTER ENABLE group must be depressed. See Figure 2-8 for an example of data listed.
11	TIME ENTRY Switches	Push button switches that allow the date and time to be set via the DATA ENTRY keyboard. Separate switches provide for the entry of either the three-digit day-of-year or the six-digit time-of-day. A power failure lamp is also included in this group to indicate the occurrence of a power interruption after the time has been set.
12	DISPLAY CONTROL Switches	Three push button switches that provide for the manual selection of displayed data during a scan sequence. The switches will not interrupt the scan sequence or the recorded data. ALL CHANNELS Selects all channels in a scan sequence for display. If the INTERVAL scan control mode is enabled, the time-of-year is displayed between scans. SINGLE CHANNEL Enables any single channel to be randomly addressed via the Data Entry keyboard. When ENTER/STEP is pressed the addressed channel is selected for display. This procedure does not alter scan sequence. DATE & TIME Selects the time-of-year clock for display.

Table 2-1. 2240B Front Panel Controls and Indicators (concluded)

REF. NO.	NAME	FUNCTION
13	SCAN CONTROL Switches	Six mutually-exclusive push button switches which provide for the selection of a scan control mode. STOP/RESET .. Terminates any previously selected scan control sequence. SINGLE Initiates the SINGLE scan control mode; i.e., one scan sequence is executed. INTERVAL INTERVAL scan control mode. The scan sequence is repeated at a programmed time interval. MONITOR..... Initiates a continuously repeated scan of the monitor channel CONTINUOUS . Initiates a continuously repeated scan sequence. All channels are measured sequentially. REMOTE Operates in conjunction with any one of the output options series (-12, -13, or -14) to provide remote start of the scan sequence if the —17 Option is not installed. When Option —17 is installed, enables full remote programming of the 2240B.

2-16. Printer Paper Installation

2-17. Standard 2¼-inch fan-fold adding machine tape is used as a recording medium for the printer. A package of fan-fold paper is shipped with the 2240B and should be installed before attempting to operate the unit. Use the following procedure for installing the printer paper:

NOTE

The printer is not designed to accommodate rolled paper tape.

- a. Fully extend the tape drawer, raise the panel above the drawer to a horizontal position and pull the paper cutter bar away from the printer drum.
- b. Pick up the paper pack so that the red marking (visible on one side of the package), is located on the bottom of the stack (some packs may not have the red markings).
- c. Remove the band from the paper and fold-out the top sheet. This provides a leader for loading the tape into the printer mechanism.
- d. Hold the pack with the leader on top and from the printer. Then slide the pack deep into the tape drawer. When properly positioned, the front of the pack should be just behind the front panel.
- e. Turn the printer on using the procedure given later in this section under Operation.
- f. Locate the arrow on the front of the printer mechanism. The arrow points to the paper-feed slot. Hold the paper leader in a horizontal position and insert it as far as possible into the feed slot ($\approx 5/8$ of an inch). Depress and hold the PAPER ADVANCE switch until 8 to 10 inches of leader have been fed through the printer mechanism.
- g. Thread the leader through the paper-cutter bar and press the bar back into position.
- h. Thread the leader through the front panel opening and close the panel. Check to ensure that the paper is still free to advance.
- i. The tape drawer should be left in the extended position, and used to store the printed tape

expelled from the printer. Guide the first two or three folds into position in the drawer.

NOTE

Simplified paper loading instructions are given on a decal located in the bottom of the paper drawer.

2-18. Printer Ribbon Installation

2-19. A printer ribbon is supplied with the 2240B and should be installed before attempting to operate the instrument. The ribbon installation location is accessible by raising the printer's front panel to the horizontal position. If the ribbon is already installed, refer to Figure 2-3 and check to ensure that the ribbon is properly positioned on the feed guides and that the ribbon spools are threaded in the proper direction. Use the following procedure for ribbon installation:

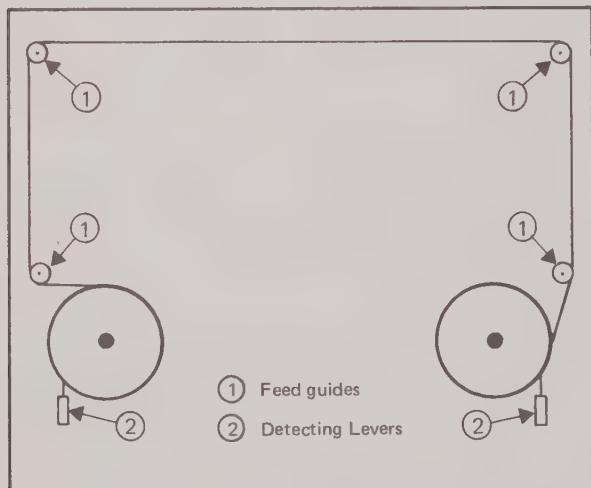


Figure 2-3. Properly Installed Ribbon

- a. Separate the ribbon spools and lay them on a flat surface with their finger-side down.
- b. Refer to Figure 2-4 and ensure that the ribbon is properly threaded on the spools.
- c. On the printer mechanism, locate the push down the detecting lever of either spool shaft (see Figure 2-3) and with the finger side of either spool pointer toward the printer mechanism, slide one of the spools onto the shaft.
- d. Unwind 6 or 8 inches of ribbon from the remaining spool, if necessary, and position the ribbon over the feed guides as shown in Figure 2-3.

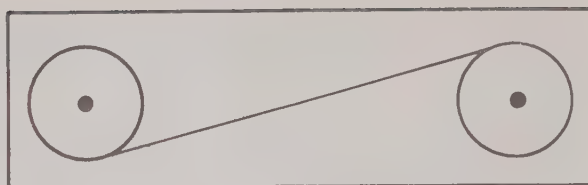


Figure 2-4. Threading Direction for Ribbon Spools

- e. Depress the detecting lever on the empty spool shaft and slip the second spool onto the shaft. Make sure there are no twists in the ribbon.

2-20. Option Information

2-21. The front panel operating instructions given in this section of the manual assume that the 2240B contains a full complement of options as shown in Figure 2-5. However, information which is unique to a particular option, such as, description, installation, interface information, maintenance, etc. is contained in the appropriate sub-section of Section 6, Option and Accessory Information.

2-22. Scanner Extension

2-23. The channel scanning capacity of the 2240B can be extended from 60 possible channels up to 1000 channels. The extension is accomplished through the use of one or more of the Model 2201A/2202A/2203A Scanner Chassis which are available as accessories. The units interconnect in a daisy-chain fashion, and the first unit in the chain connects to a rear-panel connector on the A/D Converter pcb (see location B in Figure 2-5).

2-24. Each scanner chassis is capable of housing and controlling either 10 (2202A or 2203A) or 12 (2201A) scanner blocks. Since each block contains 10 channels, a total of 100/120 channels can be added with each scanner chassis included in the daisy chain. The 2201A, 2202A and 2203A Scanner Chassis are documented in separate stand-alone instruction manuals.

2-25. Internal Switch Settings

2-26. Several control and function enable switches are contained on the interior of the 2240B. These switches are not intended for use by the operator, and are mentioned at this time for identification purposes only. Each of the switches is named and its location defined in Table 2-2. Instruction for properly setting each switch are also referenced.

2-27. Program Memory

2-28. The 2240B is equipped with a non-volatile memory which is impervious to power interruptions

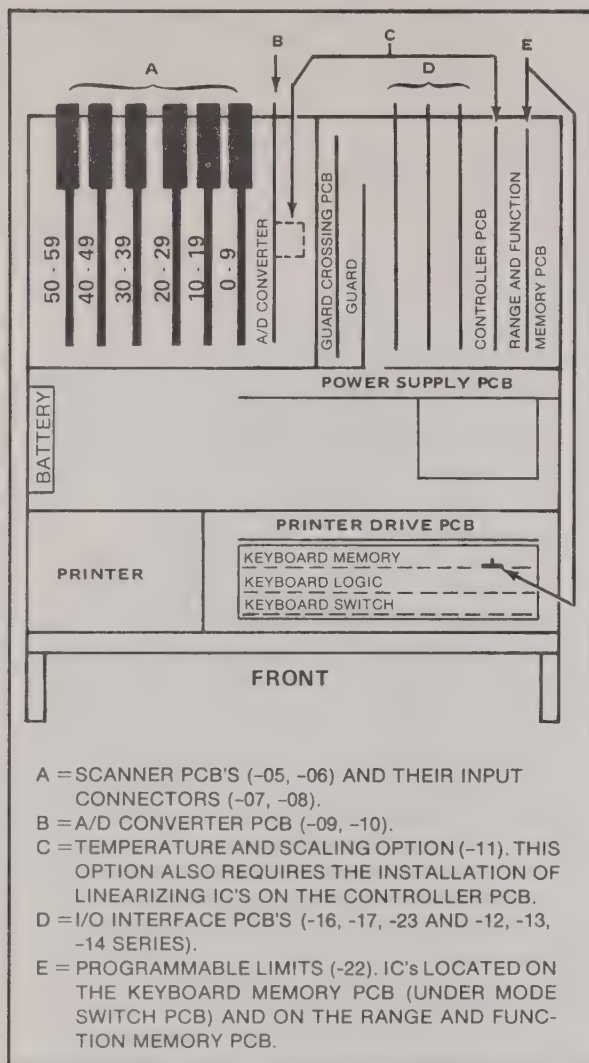


Figure 2-5. 2240B Option Installation Locations

caused by either power failures or switching the instrument to power off. The memory is maintained under these conditions by a lithium battery which is switched into service when the line operated power supply is shut down. This battery will maintain the program memory for a minimum of 5 years.

2-29. Individual/Block Mode

2-30. The basic 2240B contains the memory necessary to program up to 256 individual input channels. If more than 256 channels are required, the 2240B is operated in the block mode. That is, the first 170 channels are individually programmed and the last 830 channels are programmed as 83 blocks of 10 channels each. Thus, a total of 1000 channels (170 + 830) can be programmed when the unit is operated in the block mode.

Table 2-2. Internal Switch Information

SWITCH NAME	LOCATION (See Figure 2-5)	FUNCTION AND POSITION INFORMATION
50/60 Hz	Power Supply PCB	Para. 2-6
115/230V ac	Power Supply PCB	Para. 2-6
°C/°F	Controller PCB #3*	Para. 611-10 (See Option -11)
Block/Individual	Controller PCB #4*	Para. 2-29 (See Option -20)
Local/Remote	Controller PCB #1*	Para. 2-32
Alarms Once/All	Controller PCB #2*	Para 2-34 and Table 2-3
Fast/Slow	A/D Converter PCB (-10 Only)	See Section 6, Option -10

*Switch 1 selects local (OFF) or remote (ON) mode, when option -17 is installed.

Switch 2 selects alarms once (OFF) or alarms all (ON).

Switch 3 selects the °C (OFF) or °F (ON) scale when option 11 is installed.

Switch 4 selects the block (OFF) or individual (ON) mode of operation.

2-31. The individual or block mode of operation is selected by a switch (#4) located on the Controller PCB Assembly on the interior of the 2240B (see Figure 2-5). The individual mode is selected when the switch is in the ON position; OFF selects the block mode.

2-32. Remote Control

2-33. The 2240B is basically a manually controlled instrument. However, as shown in Figure 2-6, remote operation can be achieved through the addition of options. Currently, one-of-two remote control configurations is possible; remote start (of scan) or total remote control and programming. Remote start is enabled by the installation of one or more of the —12 through —14 output interface options. The addition of a —17 Remote Programming option enables total remote control capability. It also overrides the remote start capability of options —12, —13 and —14 and, at the same time, allows switch selection of one-of-two remote enable modes, local or remote. The local/remote switch (SW1) is located on the Controller PCB and functions as follows:

- Local (Switch 1 set to OFF)
Allows local or remote control of the 2240B to be selected by the position of the REMOTE switch in the SCAN CONTROL group (IN = remote, OUT = local). All front panel controls with the exception of the REMOTE switch, and the DISPLAY CONTROL switches, are disabled when remote control is selected.

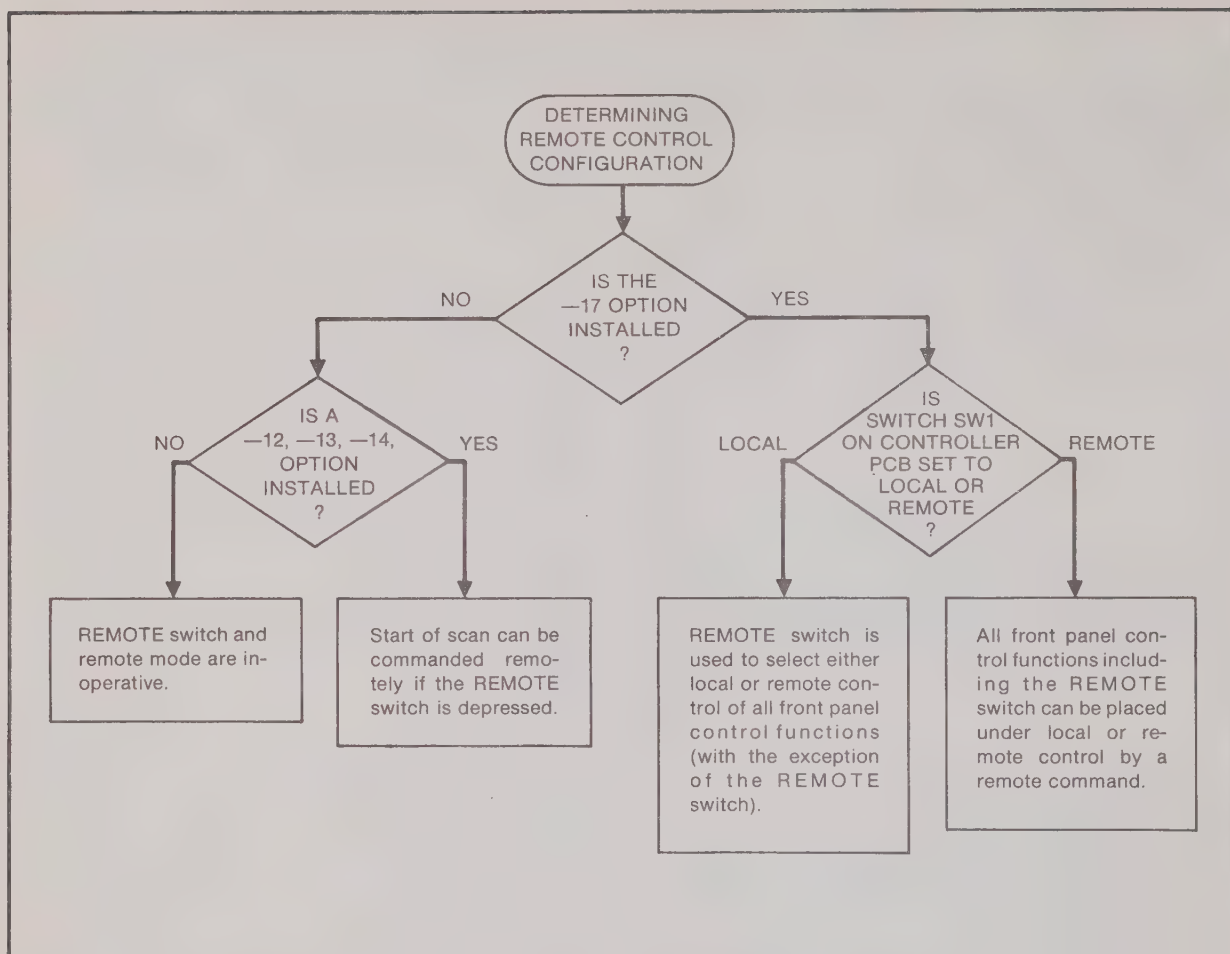


Figure 2-6. Remote Control Configurations

- b. Remote (Switch 1 set to ON)
Allows local or remote control to be selected by a remote command. Selecting remote control disables all front panel switches, except DISPLAY CONTROL, and enables total remote control of all front panel functions. The REMOTE switch is disabled for both control modes.

2-34. Power Failure

2-35. The TIME ENTRY switch group contains a lamp which blinks to indicate the occurrence of a line-power interruption during normal operation of the 2240B. The lamp begins to blink after power is restored and serves as a visual flag to indicate that the displayed date and time is in error. The restoration of line power resets the clock to zero, allowing it to operate as an elapsed time counter. Thus, the clock provides a direct read-out of the time elapsed since power was restored. Instructions for resetting the clock are given later in this section under Operation.

2-36. Output Control

2-37. The OUTPUT CONTROL switch group provides the operator with manual control over the operation of the data recording devices associated with the 2240B. The switches are divided into two separate groups: PRINTER ENABLE and EXTERNAL ENABLE. The PRINTER ENABLE switches apply only to the operation of the internal printer. The EXTERNAL ENABLE switches affect all external recording devices which are interfaced with the 2240B.

2-38. The function of the switches in both groups, as they apply to their respective recording devices, are identical with the exception of the printer's PAPER ADVANCE (paper feed) switch which is not featured in the EXTERNAL ENABLE group. Therefore, an explanation of the ALL DATA, ALARM DATA and INTERVAL DATA switches is sufficient to explain the operation of both switch groups.

2-39. The ALLDATA, ALARM DATA, and INTERVAL DATA switches are of the push-push type and

each is capable of independent operation. When all three switches are in the released or out position, the associated recording devices are inhibited from recording output data from the 2240B. Depressing one or more of the switches allows selected data to be recorded. Table 2-3 lists all of the possible switch combinations, the mode(s) in which data will be recorded, and the kind of data recorded.

NOTE

An Alarm Once/Alarm All switch (SW2) is located on the Controller PCB. It operates in conjunction with the ALARM DATA switches of the OUTPUT CONTROL group to define the output record format under alarm conditions. See Table 2-3 for switch setting information.

2-40. Scan Control

2-41. The scan sequence can be manually controlled (when the power switch is set to POWER ON) by pressing one of the following five switches in the SCAN CONTROL group: STOP/RESET, SINGLE, INTERVAL, MONITOR or CONTINUOUS. STOP/RESET allows termination of a previously selected scan sequence. SINGLE, INTERVAL, MONITOR and CONTINUOUS allow separate variations of the scan sequence to be initiated. A sixth switch, REMOTE, operates in conjunction with Options —12, —13, —14, and —17; and SW1 on the Controller PCB to enable the remote capabilities of the 2240B. See Remote Control earlier in this section of the manual.

NOTE

To avoid unwanted alteration of the switches in the SCAN CONTROL group, set the Power Switch to KEYBOARD PROGRAM DISABLE and remove the key from the switch.

2-42. The basic scan sequence is initiated by the SINGLE switch, and is keyed to manually entered program data. A simplified sequence of events in the single scan mode is as follows:

- a. The first channel relay in the program sequence closes and connects an external stimulus to the input of the A/D Converter (Option —09 or —10).
- b. The A/D Converter measures the input signal in terms of the programmed function (volts, millivolts or temperature) and provides a digital display of the results.

- c. The displayed value is compared against a programmed high and/or low limit value (Option —22).
- d. If a recording device has been enabled, the channel, measurement, and function data are recorded. Also, prior to each scan sequence, the time-of-year and the fixed heading data are recorded.
- e. The first channel relay is opened and the second channel relay in the sequence closed to connect its external input to the A/D Converter.

NOTE

Channels between the first and last channels can be skipped under program control. Therefore, the measurement channels may be separated by several skipped channels. For example, the channel sequence might appear as follows: 1, 2, 8, 14, 15, 20. Where, channel 1 is the first channel and 20 is the last channel.

- f. Steps b, c, and d are repeated.
- g. The channel relay is opened and the next programmed channel relay is closed. Its input is measured, compared and recorded.
- h. Step g is repeated for each programmed channel until the last channel has been scanned.

2-43. Variations of the single scan mode include: interval and continuous. The interval scan mode causes the single scan sequence to be repeated at a programmed time interval. The time interval is the time between the start of one sequence and the start of the next sequence. Interval time can be programmed from a minimum of 1 second to a maximum of 23 hours, 59 minutes and 59 seconds (23:59:59). A 1-second resolution can be achieved for any interval time within the 24-hour limit. The continuous mode causes the scan sequence to be continuously repeated with a minimum time between the end of one sequence and the start of the next sequence (typically $\leq$ second).

2-44. The monitor scan mode allows the operator to monitor a single selected channel during a scan sequence. The monitored channel is addressed in conjunction with the MONITOR CHANNEL switch in the SCAN FORMAT group and the DATA ENTRY keyboard. Pressing the ADVANCE ADDRESS switch incrementally advances the monitor address and allows the operator to manually scan and measure the input present at each of the accessible channels. The monitor mode is useful for both program verification and troubleshooting.

Table 2-3. Data Recorded For Various Scan Control And Output Control Modes.

OUTPUT CONTROL MODES (● - SELECTED) (○ - NOT SELECTED)			ALARM SWITCH (SW2) SETTING 	APPLICABLE SCAN MODES				DATA RECORDED							
ALL DATA	ALARM DATA	INTERVAL DATA		MONITOR	SINGLE	INTERVAL	CONTINUOUS	NONE	ALL SCAN SEQUENCE DATA	TIME OF YEAR, CHANNEL, MEASURE- MENT DATA	ONCE EACH INTERVAL	ONCE UPON ENTERING & EXITING AN ALARM CONDITION	WHENEVER AN ALARM IS ENCOUN- TERED	FOLLOWED BY: (See next line).	ALARM AT ANY CHANNEL CAUSES ALL DATA IN NEXT SCAN TO BE RECORDED
○	○	○	—	/	/	/	/	X							
○	○	●	—	/		/	/		X		X				
○	●	○	ONCE	/		/	/			X		X			
○	●	○	ALL	/	/	/	/			X			X		
○	●	●	ONCE	/		/	/		 X	X		X		X	
○	●	●	ALL	/		/	/		 X	X			X	X	
●	○	○	—						X						
●	○	●							X						
●	●	○	ONCE	/		/	/		 X	X		X		X	
●	●	○	ALL	/		/	/		X				X		X
●	●	●	ONCE	/		/	/		 X	X		X		X	

Notes:

— = Don't care

/ = Any one may be selected.

X = Indicates format and timing of recorded data.

 = SW2 on Controller PCB. Alarms once = OFF. Alarms all = ON.

2-45. Operation of the remote mode depends upon the combination of options installed in the 2240B. Figure 2-6 defines these option combinations and the remote capabilities of each. Details concerning the remote capabilities of each option purchased are given in Section 6 of this manual.

2-46. Display Control

2-47. The DISPLAY CONTROL switch group contains three switches which allow the operator to manually assign the display to read one-of-three types of data (All Channels, Single Channel or Date and Time). For example, assume that a continuous scan sequence is in progress and the operator initiates and/or executes a change in the scan format. The operator can exit the programming mode at any time and assign the display to read either all channel measurements, selected single channel measurements, or date and time. This is accomplished by pressing the appropriate switch in the DISPLAY CONTROL group and, if SINGLE CHANNEL is selected, entering channel number and

then pressing ENTER/STEP. Reassigning the display in this manner allows the operator to enter or verify program data without interrupting the scan sequence.

2-48. Print/Record Format

2-49. Measurement data generated during a scan sequence can be recorded on the printer and/or any external recording devices interfaced with the 2240B. Examples of the recording format for any given scan sequence is shown in Figure 2-7. The example assumes the printer as the recording device.

2-50. Fixed Data

2-51. Fixed data is a six-digit number which is recorded after the date and time. The number is manually entered by the operator to identify the program, lot, run, project, etc., associated with the scan sequence and can be any number from 000000 to 999999. Once entered, the number will remain fixed until a new one is entered.

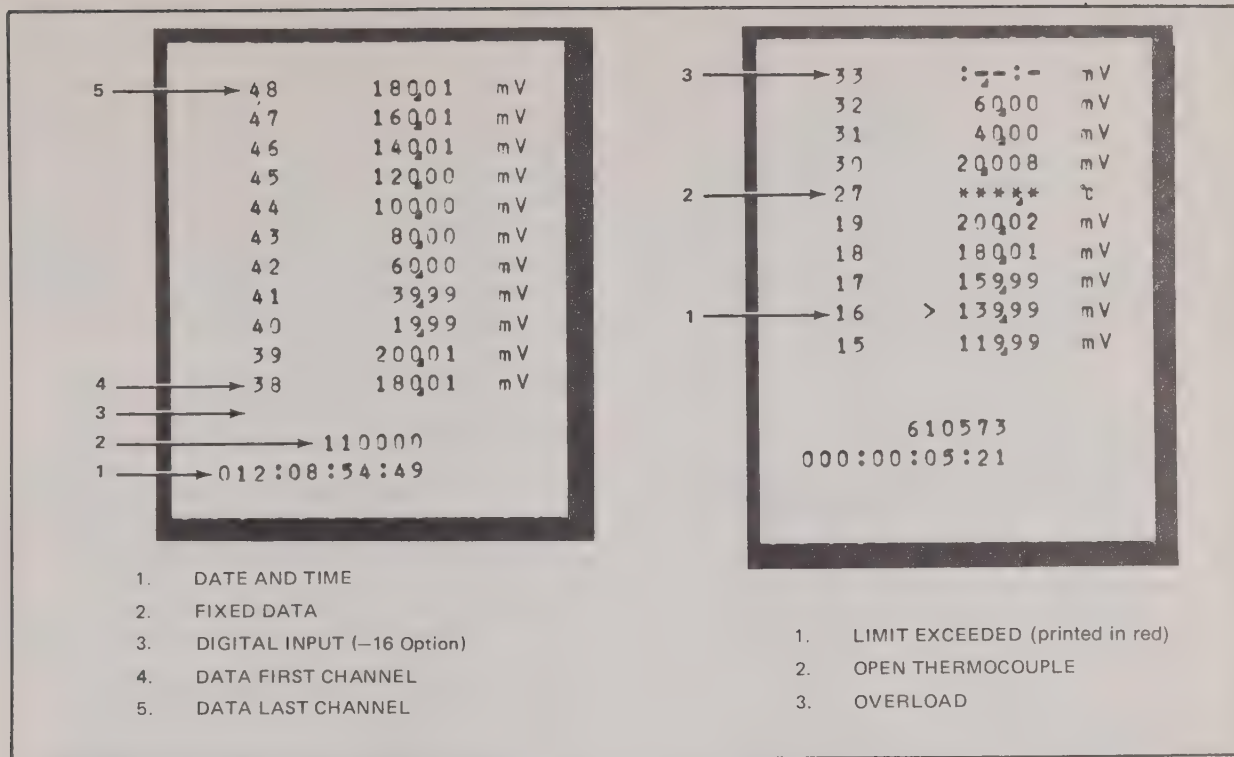


Figure 2-7. Typical Format of Printed Measurement Data

2-52. Improper Program Data

2-53. An IMPROPER ENTRY lamp is provided in the DATA ENTRY switch group to indicate that an attempt to enter illegal program data has been made. An operator error in format or data entry causes the lamp and the displayed data to begin flashing. As long as the lamp is flashing, the STEP/ENTER switch is inhibited to prevent the improper data from being entered into memory. The improper entry condition can be cleared by pressing the CLEAR ENTRY switch, or by entering new data. (When the keyboard program senses an error, it prepares itself to accept new data without the aid of the CLEAR ENTRY switch. CLEAR ENTRY is used primarily for correcting (erasing) partial entries and starting again.)

2-54. Programmable Limits

2-55. Programmable measurement limits (Option 22) are available in two blocks for up to 30 separate and variable values, each of which is addressable for use by all available channels. The limits are split into two equal groups, (1 to 15 (LIMIT A)) and (16 to 30 (LIMIT B)), and one limit from either or both groups can be assigned to a given channel. However, two limits from the same group cannot be assigned to the same channel. Therefore, when a channel measurement requires two limits (high and low), each must be taken from a separate limit group.

2-56. The actual value of a limit word can range from a minimum of -39990 to a maximum of 39990. The least-significant digit is not programmable and is always zero. Since the programmed limit value is to be compared directly against the measurement reading, care must be taken to ensure that the limit's magnitude is compatible with the selected function and range and visa-versa. For example, a limit value of 10000 can represent a limit of 10.000V, 1.0000V, 100.00 mV, 10.000 mV, 1000.0°F or 1000.0°C depending upon the selected function.

2-57. When a limit is exceeded during a scan sequence, a LIMIT EXCEEDED lamp in the PROGRAMMING switch group begins to blink, and continues to blink until it is reset. The reset is accomplished by pressing the adjacent RESET switch. Recorded limit data is also identified as greater than (>) or less than (<) the specified limit. In addition, the printer records out-of-limits data in red for easy identification. The date and time is also printed prior to each out-of-limits measurement.

2-58. Program List

2-59. The 2240B is equipped with a program-list feature which allows the operator to solicit and record the contents of the program memory. The listed information includes date and time; time interval; fixed

data; monitor channel; all available limit addresses (30 maximum) and their respective sense, polarity and value; and channel programming for each channel from first to last. Channel programming includes function and limit data assigned to each channel. A sample of the program list format is given in Figure 2-8.

2-60. The program list feature should be employed both before and after entering new program data. By listing the old program, the user will know what must be added to or deleted from memory during the reprogramming process. Listing a newly entered program allows the operator to verify its accuracy.

NOTE

The program list feature requires that both the ALL DATA switch in the PRINTER ENABLE group and the RESET switch in the SCAN CONTROL switch group be depressed prior to pressing the PROGRAM LIST switch.

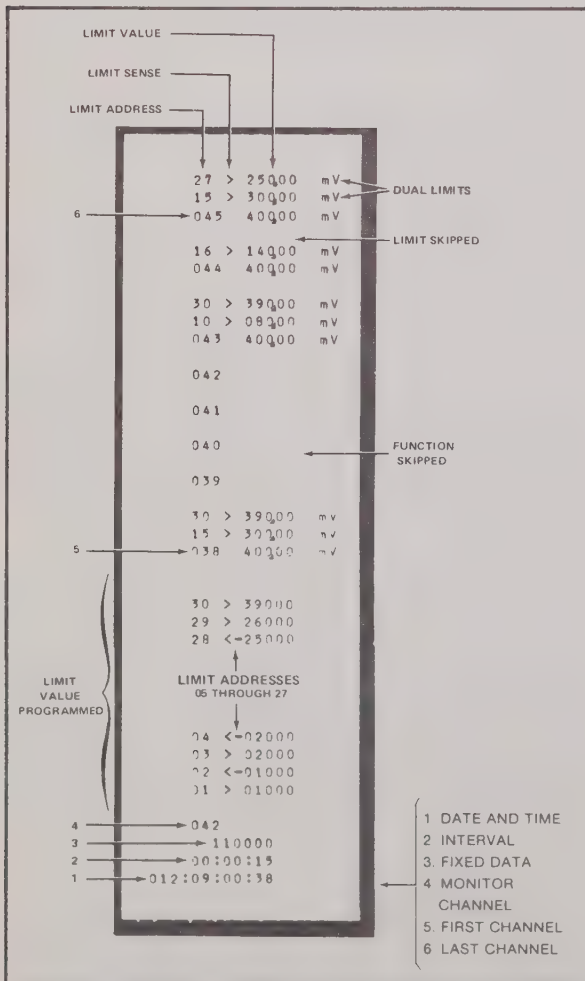


Figure 2-8. Typical Format of Program List Data

2-61. Audio-Tone Keyboard

2-62. As a programming aid, the 2240B includes the capability of rejecting the entry of both invalid and improperly formatted program data. The entry of each valid data character is accompanied by an audio tone when one of the keyboard switches is depressed. The tone indicates that the data is valid and has been accepted by the 2240B. The absence of the audio tone indicates that the data is either invalid or improperly formatted and has not been accepted by the 2240B.

2-63. OPERATION

2-64. Turn-On Procedure

2-65. Use of the following procedure is suggested for initial turn-on of the 2240B. With reference to the previous paragraphs turn on the 2240B as follows:

- Connect the 2240B to line power (see paragraph 2-6).
- Install available options, as required.
- Connect interface cables, as required.
- Press the STOP/RESET switch in the SCAN CONTROL group.
- Insert the key in the Power switch and set it to POWER ON. The display should illuminate and read 2240 3 for approximately 3 seconds. After the 3 seconds, the display will indicate elapsed time starting at 000 00:00:03 (3 seconds).
- Press the ALL DATA switch in the PRINTER ENABLE group.
- Press the PROGRAM LIST switch. The program currently in memory will be printed.

2-66. Turn-Off Procedure

2-67. The Turn-Off Procedure consists of a single step: Insert the key into the Power switch and set it to POWER OFF.

NOTE

The turn-off procedure will not clear or alter the program data present in the 2240B.

2-68. Entering Program Data

2-69. Meaningful operation of the 2240B requires the manual entry of a series of program words to define the

variable associated with a scan sequence. The procedures required to enter each variable are given in the following paragraphs. Completion of the entire series of procedures, in the order given, is recommended to familiarize the inexperienced operator with the programming requirements of the 2240A. However, it is not necessary for the experienced operator to complete the procedures in the order given. Nor, is it necessary to complete an entire procedure. Thus, variables not affected can be omitted from any of the procedures.

NOTE

Generating a written program prior to entry simplifies the programming process, and ensures duplication when re-entering old programs. A recommended format for a program form is given in Figure 2-9.

2-70. INITIAL PROCEDURE

2-71. Perform the following procedure prior to attempting to program the 2240B:

- a. Complete the Turn-On Procedure given earlier in this section.
- b. Set the Power switch to POWER ON.
- c. Release all switches in the EXTERNAL ENABLE section of the OUTPUT CONTROL group.

NOTE

After the 2240B has been programmed, accidental alteration of the program can be avoided by setting the Power switch to KEYBOARD PROGRAM DISABLE and removing the key from the switch.

2-72. TIME ENTRY

2-73. The date and time must be updated after the Turn-On Procedure is performed, and after a power interruption has occurred. The POWER FAILURE/RE-ENTER TIME lamp flashes to indicate that the clock is in error. Use the following procedure to update the date and time.

- a. If the DAY display indicates the wrong date, press the DAYS switch in the TIME ENTER group. The HRS: MIN: SEC portion of the display will go blank.
- b. On the DATA ENTRY keyboard, serially enter the Julian day-of-year or an equivalent three-digit date code. As each digit is entered, it will be presented on the DAY portion of the display. If the entry was made incorrectly, press the CLEAR ENTRY switch on the DATA

ENTRY keyboard and then re-enter the proper day.

NOTE

When using the DATA ENTRY keyboard, it is not necessary to enter leading zeros.

- c. After the desired day is displayed, enter it into memory by pressing the ENTER/STEP switch on the DATA ENTRY keyboard. The DATA display should now be illuminated.

NOTE

When the HR, MIN, SEC switch is pressed the clock is not actually stopped. It continues to run and can be recalled at any time prior to pressing the ENTER/STEP switch by pressing DATE AND TIME.

- d. Press the HR MIN SEC switch in the TIME ENTRY group. The DAY portion of the display should go blank.
- e. Serially enter the desired time on the DATA ENTRY keyboard; hours first, seconds last. Remember that the clock is to be restarted at some future time and should be synchronized with the true time-of-day. Therefore, the time entered on the keyboard should agree with the time at which the clock is to be started.
- f. Synchronize and start the clock by pressing the ENTER/STEP switch.

2-74. SCAN FORMAT

2-75. The scan format program involves the variables which define the scope of a scan sequence. These include; fixed data, first channel, last channel, time interval, and monitor channel address. Use the following procedure to program the scan format:

- a. Press the FIXED DATA switch in the SCAN FORMAT group. The six-digits currently in memory will be presented on the DATA display.
- b. If the fixed data is incorrect, serially enter the desired data on the DATA ENTRY keyboard (MSD first) and press the STEP/ENTER switch. If the original data is correct, no action is required.
- c. Press the FIRST CHANNEL switch in the SCAN FORMAT group. The first channel address currently in memory will appear on the CHANNEL display.

FLUKE 2240B PROGRAM FORM						
FIRST CHANNEL _____ INTERVAL _____ LAST CHANNEL _____ FIXED DATA _____ MONITOR CHANNEL _____ SINGLE CHANNEL _____					TEST NO. _____ SH _____ OF _____ DATE _____	
CHANNEL PROGRAM				LIMIT A PROGRAM		
CHANNEL ADDRESS	FUNCTION	ADDRESS LIMIT A (1-15)	ADDRESS LIMIT B (16-30)	LIMIT ADDRESS	SENSE (HI/LO)	VALUE AND POLARITY
				1		
				2		
				3		
				4		
				5		
				6		
				7		
				8		
				9		
				10		
				11		
				12		
				13		
				14		
				15		
LIMIT B PROGRAM				LIMIT ADDRESS	SENSE (HI/LO)	VALUE AND POLARITY
				16		
				17		
				18		
				19		
				20		
				21		
				22		
				23		
				24		
				25		
				26		
				27		
				28		
				29		
				30		

Figure 2-9. 2240B Program Form, Recommended Format

- d. If the channel displayed is incorrect, serially enter the desired first channel on the DATA ENTRY keyboard and press the ENTER/STEP switch. If the original channel is correct, no action is required.
- e. Press the LAST CHANNEL switch in the SCAN FORMAT group. The last channel currently in memory will appear on the CHANNEL display.
- f. If necessary, enter the correct last channel on the DATA ENTRY keyboard and press the ENTER/STEP switch.
- g. Press the INTERVAL HR MIN SEC switch in the SCAN FORMAT group. The time interval currently in memory will be displayed in hours, minutes, and seconds on the DATA display.
- h. If necessary, enter the desired time interval on the DATA ENTRY keyboard and press the ENTER/STEP switch.
- i. Press the MONITOR CHANNEL switch in the SCAN FORMAT group. The current address of the channel to be monitored will appear on the CHANNEL display.
- j. If a new monitor channel is desired, enter it on the DATA ENTRY keyboard and press the ENTER/STEP switch.
- a. Press the LIMITS ENABLE switch in the PROGRAMMING switch group. The ENTER ADDRESS lamp will light.
- b. Enter the desired limit address (1 through 30) on the DATA ENTRY keyboard and verify its correctness on the CHANNEL display.

NOTE

If a selected channel is larger than allowed by the loaded —22 Options the channel display and the improper entry LED will flash when ENTER/STEP is pressed.

- c. Press the ENTER/STEP switch on the DATA ENTRY keyboard. The ENTER ADDRESS lamp will go out and the ENTER SENSE lamp will light.
- d. Enter HI LIMIT or LO LIMIT as desired on the DATA ENTRY keyboard. The ENTER SENSE HI/LO lamp will indicate the selected sense. Press the ENTER/STEP switch. The ENTER SENSE lamp will go out and the ENTER VALUE lamp will light.
- e. Enter the numeric value of the addressed limit on the DATA ENTRY keyboard. If the value is to be negative, press the minus (–) key before, during or after the numeric value is entered. Positive values do not require a polarity entry.

NOTE

The number of digits in a limit value should be compatible with the measurement function it is to be compared with. For example, a limit value of 10000 can represent a limit of 10.000V, 1.0000V, 100.00 mV, 10.000 mV, 1000.0° F or 1000.0° C depending upon the selected function.

- f. Press the ENTER/STEP switch. The ENTER VALUE lamp will go out and the ENTER ADDRESS lamp will light.

NOTE

Limit values outside the range of ± 39990 may not be entered.

- g. Progress to the next applicable limit address by either entering it via the DATA ENTRY keyboard and pressing the ENTER/STEP switch, or pressing the ADVANCE ADDRESS switch until the correct address is displayed.
- h. Update the limit sense and limit value by repeating steps d, e and f of this procedure.

2-76. LIMITS PROGRAMMING

2-77. The memory required to program measurement limits is available only when the 2240B is equipped with either one or two of the set-point limits option. The following procedure assumes that two Fifteen Single-Limit Set Point Options (—22) have been installed in the 2240B. Prior to attempting to program the limits, the operator should familiarize himself with the limit capabilities available in his 2240B. Use the following procedure to assign limit magnitude, polarity, and high or low sense to one or more of the 30 possible limit addresses. To simplify programming, the limits assigned to each address should be determined prior to entering limit address data in the Channel Programming procedure.

NOTE

When two limits are associated with a single measurement, care must be taken to ensure that the limits appear in separate address groups 1 through 15 for group A, and 16 through 30 for group B. High or low sense can be assigned to any address in either group. However, two limits within one group cannot be utilized simultaneously.

- i. Repeat steps g and h to update any additional limits for use in the scan sequence.

2-78. CHANNEL PROGRAMMING

2-79. Use the following procedure to assign the appropriate measurement function and limits address(es) to each channel included in a scan sequence; i.e., first channel to last channel as defined in the Scan Format program procedure:

- a. Press the CHANNEL ENABLE switch in the PROGRAMMING group. The ENTER ADDRESS lamp will light.
- b. Using the DATA ENTRY keyboard enter the address of the first channel in the scan sequence and press the ENTER/STEP switch. The selected channel and the currently programmed function will be displayed. The ENTER ADDRESS lamp will go out and ENTER FUNCTION will light.
- c. On the DATA ENTRY keyboard, press the appropriate voltage/temperature range (or skip) for the displayed channel, and then, press the ENTER/STEP switch. The ENTER FUNCTION lamp will go out and the ENTER ADDRESS LIMIT A lamp will light.

NOTE

All measurement functions are available as options. Therefore, prior to attempting to select a function, determine whether or not it is available in your 2240B. The IMPROPER ENTRY lamp will light when an invalid function is selected. The condition is cleared by pressing the CLEAR ENTRY switch or selecting an available function.

NOTE

When the ENTER ADDRESS LIMIT A lamp lights, the address of the limit value assigned to that channel is shown on the DATA display. If a limit is not currently assigned the display will read s s s for skip.

- d. If a limit from address group A (1-15) is required, enter its address on the DATA ENTRY keyboard and press the ENTER/STEP switch. If a limit from address group A is

not required, press the SKIP switch adjacent to the ENTER ADDRESS LIMIT A lamp and press the ENTER/STEP switch. In either case the ENTER ADDRESS LIMIT A lamp will go out and the ENTER ADDRESS LIMIT B lamp will light.

- e. Either skip or enter a limit address code from address group B (16-30) and press the ENTER/STEP switch. The ENTER ADDRESS LIMIT B lamp will go out and the ENTER ADDRESS lamp will light.
- f. Press the ADVANCE ADDRESS switch. The CHANNEL display will advance to the next channel in the sequence and the ENTER FUNCTION lamp will light.
- g. With reference to the following notes, repeat steps c through f of this procedure for each channel in the scan sequence.
 1. Any combination of channels between the first and last channels can be skipped by sequentially pressing the SKIP and ENTER/STEP switches when the ENTER FUNCTION lamp is lit. When a channel is skipped, the limit address will be ignored.
 2. When a series of channels require identical function and limit data, program the first channel in the series using the above procedure. Then alternately press the ADVANCE ADDRESS and the REPEAT switches for each like channel.

2-80. SINGLE CHANNEL PROGRAMMING

2-81. Use the following procedure to address and select the single channel to be displayed:

- a. Press the SINGLE CHANNEL switch in the DISPLAY CONTROL group. The current address of the single channel will appear on the CHANNEL display.
- b. If a new single channel is desired, enter it on the DATA ENTRY keyboard and press the ENTER/STEP switch.
- c. The displayed channel can be advanced by pressing the ADVANCE ADDRESS switch.

Section 3

Theory of Operation

3-1. INTRODUCTION

3-2. This section of the manual contains an overall functional description followed by a Block Diagram Analysis of the Model 2240B Data Logger. Both descriptions are supported by simplified block diagrams. Detailed schematics of the individual pcb assemblies are given in Section 8 of this manual.

3-3. OVERALL FUNCTIONAL DESCRIPTION

3-4. The 2240B, as shown in Figure 3-1, is a data processor and recorder which is expandable, through the use of optional plug in modules, into a user designed data acquisition system capable of servicing up to 1000 channels of guarded analog data. Logically, the 2240B can be divided into two major sections, analog and digital. The analog section comprises the Scanner PCB's and the A/D Converter. The remaining blocks comprise the digital section.

3-5. The analog section of the 2240B is an electrically isolated scanner and a/d converter which is used to interface the individual channels of analog data with the control logic contained in the digital section. Analog data is presented to the analog section through a series of plug-in relay scanner pcb's (up to 100 ten-channel scanner pcb's can be serviced). The individual channels are energized under digital control, and the selected channel data is measured and digitized by a dual-slope a/d converter (the analog portion of which is contained on the A/D Converter PCB while the digital portion is contained on the Guard Crossing PCB). After each channel measurement is completed, the Guard Crossing PCB transfers the digitized measurement data across an optical isolator to the digital section. All additional processing of measurement data (e.g., display, recording and comparison) is accomplished by the digital section.

3-6. The digital section of the 2240B is a bus oriented system based upon a four-bit-parallel micro-processor (which is an integral part of the Controller). Three buses are used to route data within the digital section. Two are unidirectional control buses, and the third is a bidirectional data bus (which is used to exchange data between the microprocessor and the other elements of the digital section).

3-7. The control buses (four lines each) are identified as Control Bus A and Control Bus B, and are mutually exclusive in operation. Both control buses are used by the Controller to transmit address data to the various elements (peripherals) of the digital section. When a particular peripheral is addressed, communications between it and the Controller are possible via the bidirectional Data Bus. The address codes and assignments for both Control Bus A and Control Bus B are given in Table 3-1.

3-8. Each address code, in addition to addressing a particular peripheral, also defines the communication function the peripheral is to perform (i.e., transmit or receive). Therefore, peripherals which are capable of both transmitting and receiving data are assigned multiple address codes. Other peripherals, such as the Display, are only capable of receiving data, and therefore, require only one address code. Similarly, the Mode switches are assigned a single address code because they are only capable of transmitting data.

3-9. When an address code is placed on either of the control buses (A or B), the corresponding peripheral is enabled to perform the solicited function; transmit or receive. If a transmit function is enabled, (e.g., the Mode switches are addressed to transmit data on the Data Bus when a binary coded 8 (1000) is placed on Control Bus A), the responding peripheral immediately places its first 4-bit character onto the Data Bus. When the Controller

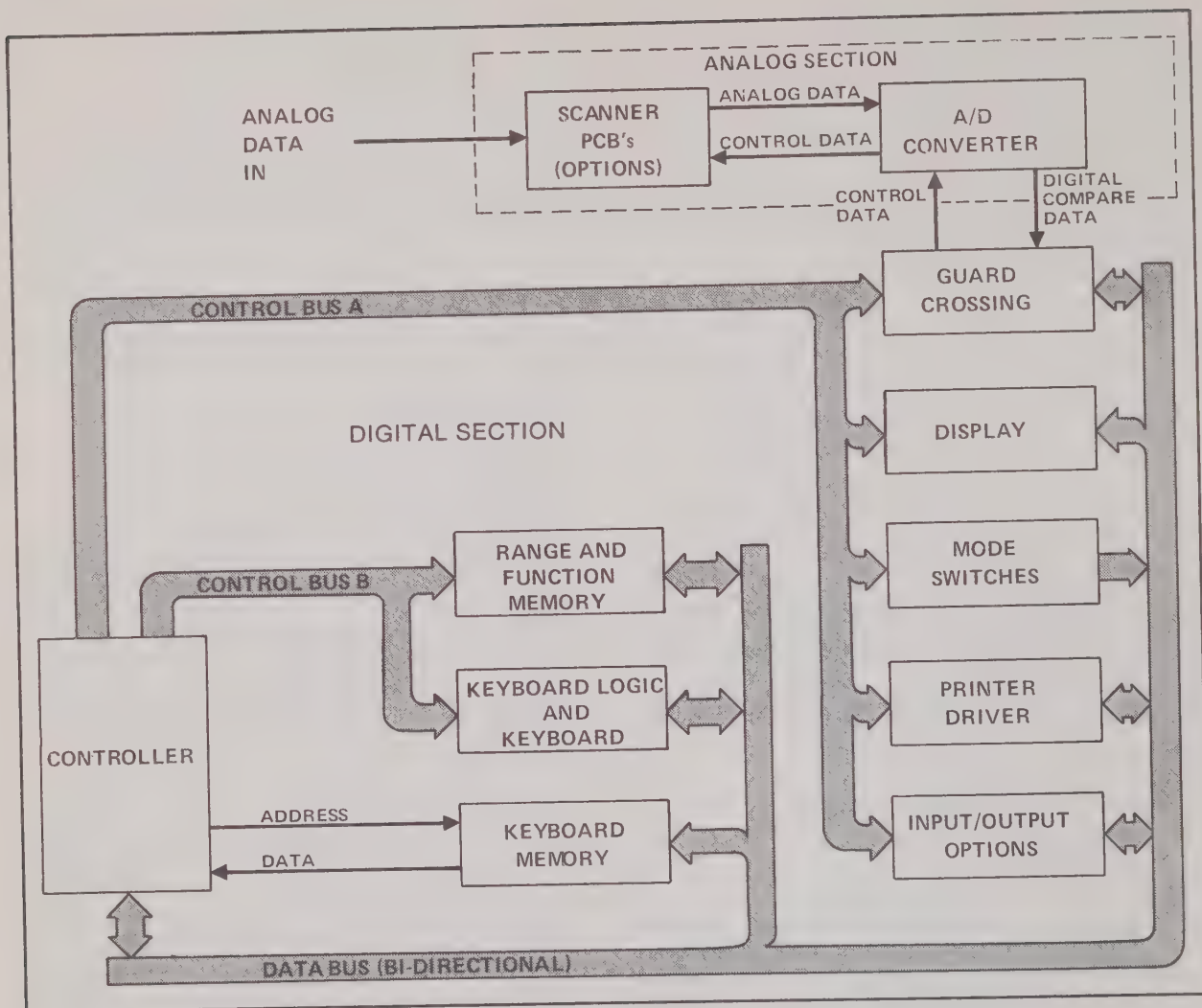


Figure 3-1. 2240B Data Logger, Simplified Block Diagram

Table 3-1. Control Bus Address Codes

CONTROL BUS A		CONTROL BUS B	
CODE* 3 2 1 0	ASSIGNMENT	CODE* 3 2 1 0	ASSIGNMENT
0 0 0 0	Null Character	0 0 0 0	Null Character
0 0 0 1	Guard Crossing Transmit	0 0 0 1	R&F Transmit (Memory)
0 0 1 0	Guard Crossing Receive	0 0 1 0	Limit A Transmit (Memory)
0 0 1 1	Guard Crossing Status	0 0 1 1	Limit B Transmit (Memory)
0 1 0 0	Output Receive	0 1 0 0	Channel Address Receive
0 1 0 1	Printer Receive	0 1 0 1	R&F Receive (Memory)
0 1 1 0	Remote/Output Status	0 1 1 0	Limit A Receive (Memory)
0 1 1 1	Input Transmit	0 1 1 1	Limit B Receive (Memory)
1 0 0 0	Mode Switch Transmit	1 0 0 0	Keyboard Receive
1 0 0 1	Display Receive	1 0 0 1	Keyboard Transmit
1 0 1 0	Not Used	1 0 1 0	Keyboard Status
1 0 1 1	Remote Receive	1 0 1 1	Not Used
1 1 0 0	Configuration Transmit	1 1 0 0	Alarm Output Receive
1 1 0 1	Printer/Interval Status	1 1 0 1	Not Used
1 1 1 0	Remote Transmit	1 1 1 0	Not Used
1 1 1 1	Not Used	1 1 1 1	Not Used

*Each control bus contains 4 lines. Control Bus A = CA0 through CA3. Control Bus B = CB0 through CB3.

reads the Data Bus it generates an In strobe. This strobe is used by the addressed peripheral to move the next character for transmission onto the Data Bus. The process is repeated until all of the characters (determined by the Controller) have been transmitted. At that time the Controller removes the address code from the Control Bus and replaces it with a Null-Character Code, 0000. If the receiver function is enabled, the process is similar. However, data moves from the Controller to the addressed peripheral, and an Out strobe is generated to allow the peripheral to receive each data character.

3-10. Three of the peripherals perform functions which are not normally synchronized by the Controller. They are the Power Supply, the Printer and the Guard Crossing. The Power Supply generates a 1 Hz clock pulse to maintain the time-of-year clock, the Printer records data supplied via the data bus and the Guard Crossing sends a/d measurement data to the Controller via the Data Bus. Since the operation of these peripherals is not synchronized with the Controller, each is provided with an interrupt line (IRQ) to notify the Controller that they are ready to perform their function. When any one of the units pull the IRQ line, the Controller responds by interrupting its normal data processing routine and sequentially requesting the status of each of the three peripherals; Guard Crossing, Printer and Power Supply, respectively. The interrupting unit is identified by its status code and serviced as necessary. When multiple interrupts occur, priority is established by the status interrogation sequence. (The interrupt circuit for the Power Supply's 1 Hz output is actually contained on the Controller PCB.)

3-11. BLOCK DIAGRAM DESCRIPTION

3-12. Introduction

3-13. A block diagram description of the 2240B is given in the following paragraphs. The description is keyed to the detailed block diagram shown in Figure 3-2. Each block or group of blocks represents a pcb assembly which is supported by a detailed schematic in Section 8 of this manual.

3-14. Controller PCB Assembly

3-15. The Controller PCB Assembly contains the microprocessor set and its associated program memory and control circuitry. The microprocessor set consists of CPU (U9), Memory Interface (U10) and four RAM's (U19, U20, U21, U31). ROM's U3, U4, U5, U6, U11 and U12 comprise the program memory. Supporting control circuits include a 20 Clock Generator, the Interrupt Circuit and the Configuration switches.

3-16. MICROPROCESSOR SET

3-17. The microprocessor set solicits and responds to program data stored in four separate locations; the Control Program ROM's, the Configuration ROM's, the Temperature ROM and the Keyboard Memory (peripheral). The Control Program ROM's contain the program data that determines the basic characteristics of the 2240B. The Configuration ROM's and the Temperature ROM contain alternate temperature measurement programs that can be enabled under program control. The Keyboard Memory (which can be either manually programmed via the front panel keyboard or remotely programmed via the —17 Option, when installed) provides the microprocessor set with the following data: First Channel, Last Channel, Monitor Channel, Interval, Fixed Data and Limit Data Values for Limit Addresses 1 through 30.

3-18. To access data in one of the four program data locations, the CPU (U9) generates a 12-bit address in the form of 3 serial, 4-bit characters. These characters are presented to the Memory Interface (U10) where they are assembled into a 12-bit parallel address word, and placed on the ROM Address Bus. The address word is then presented in parallel to each of the four program data locations. To ensure a response from only the desired program data location, an additional location-enable line is required. Control data for this line is derived from program content. RAM U19, 1-of-10 decoder U15, and RS flip-flop U30 generate the enable for the Temperature and the Control Program ROM's. The Configuration PROM and the Keyboard Memory are enabled by RAM U31 and 1-of-10 decoder U16 via the Program Memory (PM) output of U10.

3-19. Program data from the addressed program-data location is placed on the 8-bit ROM data Output Bus (01 through 08) and read by the Memory Interface. The data is then either returned to the CPU for further processing or placed on the Data Bus for use by the peripheral I/O pcb assemblies.

3-20. Since the Control Program ROM's (U3, U4, and U6) contain the instructions which determine the characteristics of the 2240B, they must be addressed when the unit is initially energized. This is accomplished by forcing U19 to present a binary coded 7 (0111) to the 1-of-10 decoder U15, thereby, enabling the Control Program ROM's to respond to the initial 12-bit address on the ROM Address Bus. Subsequent program data locations are accessed under the direction of the Control Program.

3-21. Control and Response Data to and from the Controller PCB Assembly is routed over the bi-directional Data Bus under the direction of the Control Program ROM's. The appropriate peripheral and their

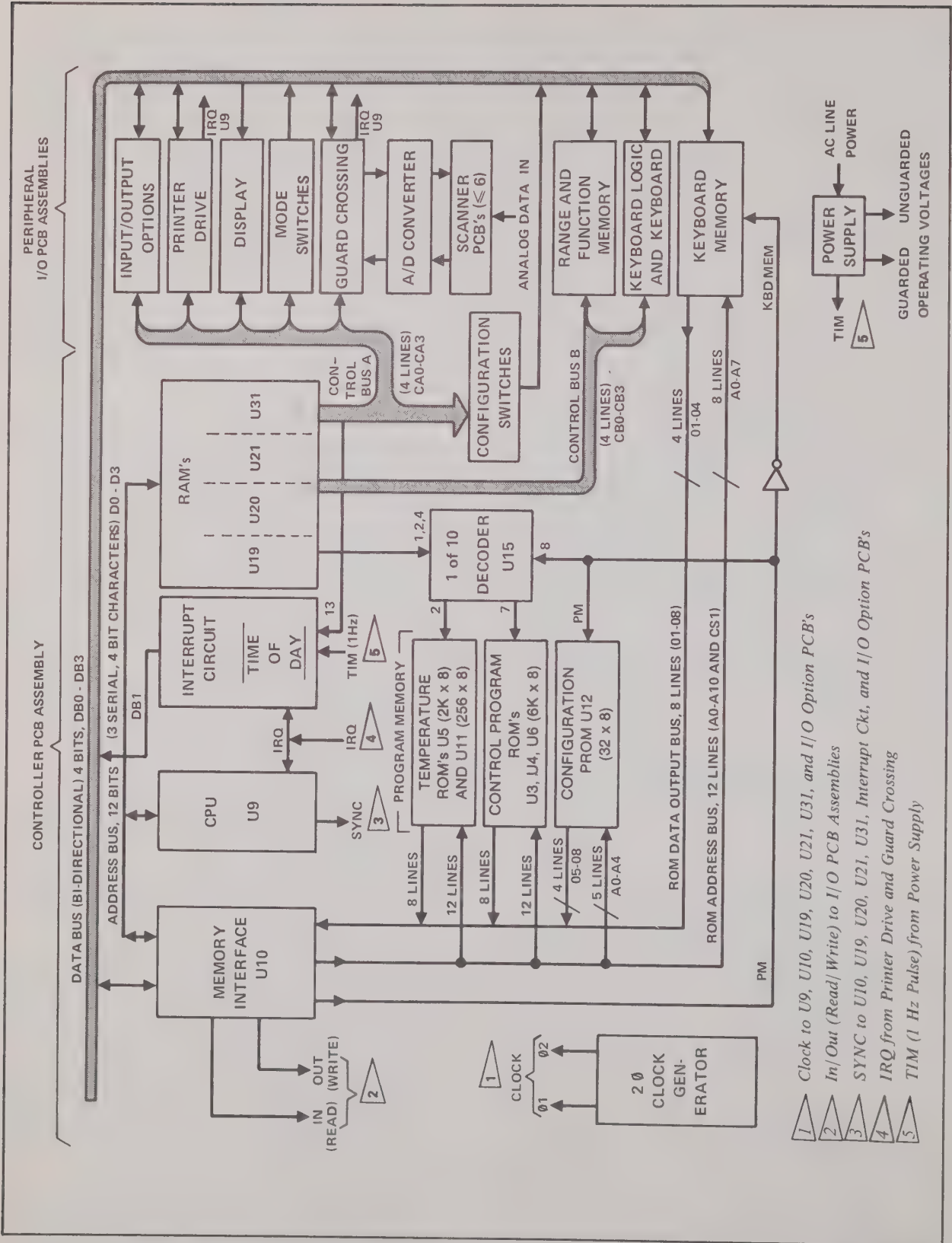


Figure 3-2. 2240B Data Logger, Detailed Block Diagram

desired response (transmit or receive) are solicited by address codes placed on Control Bus A or Control Bus B. These codes are derived from the control program via RAM's U20 and U21. If the addressed peripheral is to return (transmit) data to the Controller PCB assembly, the Memory Interface U10 generates an In strobe to retrieve character-serial data via the Data Bus. If the peripheral is to receive data from the Controller PCB Assembly, the Memory Interface generates an Out strobe after it places each character on the Data Bus. This enables the addressed peripheral to synchronize the serial I/O data with the Controller PCB Assembly.

3-22. TWO PHASE CLOCK GENERATOR

3-23. The microprocessor set is synchronized to a 20, crystal controlled clock. The clock circuitry consists of a synchronous counter U8, a 5.185 MHz crystal Y1, gates U7 and U11, and a level shifter U2.

3-24. In operation crystal Y1 provides the time base (1/5.185 MHz) for a free running oscillator. Counter U8 divides the oscillator output by seven and presents its Q1 (2) and Q2 (4) outputs to gates U7B (01) and U7C (02) for decoding. The decoded outputs are then presented to U2 where the 20 TTL output signals are shifted to the +5 and -10 volt levels required by the microprocessor set. The timing of the 20 clock is shown in Figure 3-3.

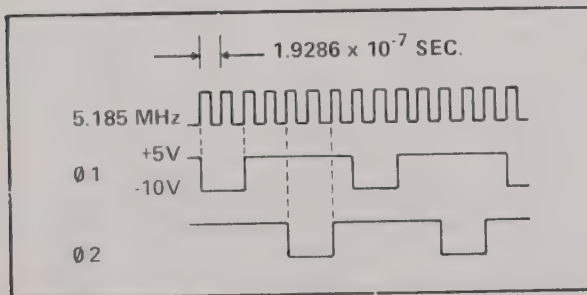


Figure 3-3. Two Phase Clock Timing Diagram

3-25. CONFIGURATION SWITCHES

3-26. The positions of the four Configurations switches, SW1 through SW4, are read by the microprocessor Set when the 2240B is power up. The switches are used as selectable variables which operate in conjunction with the data stored in program memory. Switch SW1 selects Alarms All or Alarms Once. Switch SW2 selects the Local or Remote control mode. Switch SW3 defined the temperature scale, °C or °F, and SW4 selects the individual or block mode of programming.

3-27. After the 2240B is energized, the Microprocessor Set places a binary coded 12 on Control Bus A. The address is detected by U29 which, in turn, enables the tri-state driver U27. All switch positions are placed on the Data Bus by U27, and read by the CPU when the

Memory Interface generates an In strobe. Switch data is assigned to the Data Bus as follows: SW1 to DB3, SW2 to DB2, SW3 to DB1, SW4 to DB0. After the switch data is read, the binary coded 12 address is removed from Control Bus A and the tri-state driver U27 reverts to its normal high impedance output state.

3-28. INTERRUPT CIRCUIT

3-29. The Interrupt Circuit comprises flip-flops U18, gates U13, U24, and U29A, tri-state buffer U27 (E2 half), and transistor Q4. The circuit operates in conjunction with the 1 Hz time interval marker (TIM, from the Power Supply) to update the date and time in the CPU. When a TIM pulse is generated (+5V dc), the next CPU Sync pulse sets flip-flop U18B. Subsequently, the IRQ line is pulled low by transistor Q4. As the CPU interrogates the status of the interrupt peripherals (Guard Crossing, Printer and Power Supply), it places a binary coded 13 on Control Bus A. This address is detected by U29A which, in turn, enables U27. The output of U18A is routed through U27 and a binary coded 2 is placed on the Data Bus (DB1). An In strobe is generated by the microprocessor to read the Data Bus and, thereby, update the current date and time. As the Data Bus is read the In strobe sets flip-flops U18 and the IRQ line is cleared. The next Sync pulse clocks flip-flop U18 to remove the data from the Data Bus. When the TIM probe returns low, the next Sync pulse clocks flip-flops U18 to the reset state so that the process can be repeated when the next TIM pulse occurs.

3-30. Keyboard Switch and Keyboard Logic PCB Assemblies

3-31. The Keyboard Switch and Keyboard Logic PCB Assemblies, as shown in Figure 3-4, are Controller peripherals designed to function as a unit and to provide the operator-interface necessary for local control and programming the 2240B. In the local mode program data is manually presented to the 2240B through a series of momentary-type switches that comprise a portion of the Keyboard Switch PCB Assembly. When any keyboard switch is pressed, it is detected by the Keyboard Logic PCB and analyzed by the Controller to determine its validity. In response to a valid input, the Controller interrogates the Keyboard Logic, accepts the entered data and returns a series of keyboard instructions to prompt the subsequent action of the operator. These instructions always include an audio tone to indicate the acceptance of entered data, and may include an illuminated prompting LED if a particular programming sequence is required. Additional prompting LED's are used to notify the operator of abnormal operating conditions. They are: POWER FAILURE to indicate the interruption of line power, IMPROPER ENTRY to flag the attempted entry of illegal data or format, and LIMIT EXCEEDED to indicate that a measurement value has exceeded its programmed limit value.

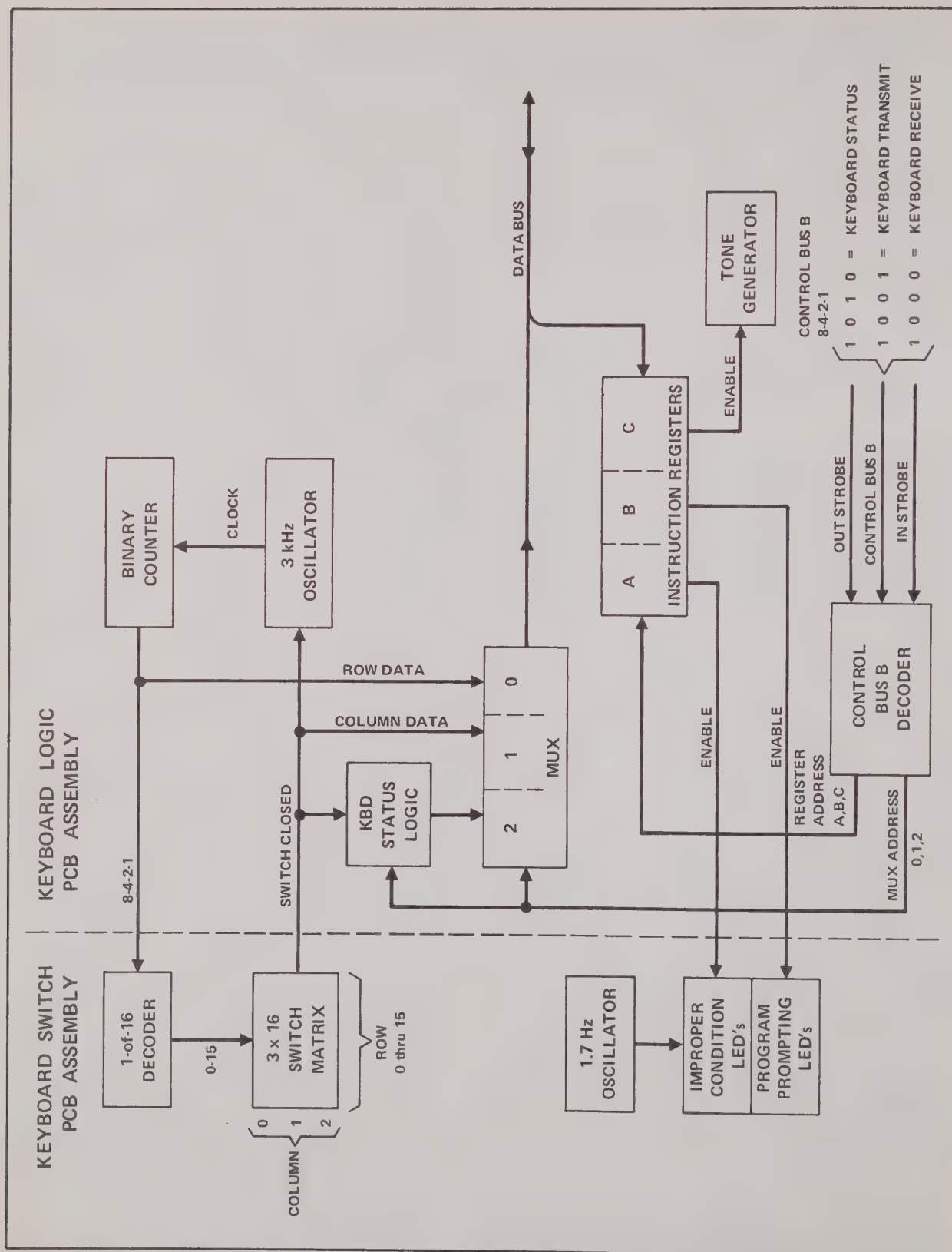


Figure 3-4. Keyboard Switch and Keyboard Logic, Simplified Block Diagram

3-32. Operation begins when power is applied to the circuit. A 3 kHz oscillator free runs to provide a clock input to a four-bit binary counter which, in turn, drives a 1-of-16 decoder. The decoder outputs are connected to the individual rows of a 3-column by 16-row switch matrix. Since the counter continually scans the matrix rows, a switch depression in any row will cause one of the three columns buses to go low. When this occurs, a switch closed signal is generated and the 3 kHz oscillator is stopped. As a result the matrix co-ordinates of the depressed switch are identified. The counter output defines the matrix row and the low column output defines the matrix column. When the matrix switch is released the scanning cycle is resumed.

3-33. Periodically, the Controller interrogates the status of the Keyboard Logic PCB to see if an attempt to enter program data is being made. The interrogation is initiated when the Controller places a binary coded 10 on Control Bus B. A decoder on the Keyboard Logic PCB detects the code and enables channel 2 of a three-channel multiplexer (MUX). Channel 2 data is placed on the Data Bus and returned to the Controller. If the Controller recognizes the following two conditions on the Data Bus (DB0 through DB3) it places a binary coded 9 on Control Bus B as a command for the keyboard to transmit data. If the conditions are not met, the Controller ignores the response and resumes its other activities.

DB0 — A keyboard switch must be depressed.

DB3 — The depressed switch must represent new data (i.e., it has not been read since it was last depressed).

3-34. The receipt of a Keyboard Transmit code (binary 9) causes the Control Bus B Decoder to enable Channel 1 of the three channel multiplexer and, thereby, place the closed-switch, column-coordinate data (Column 0, 1 or 2) onto the Data Bus. An In strobe from the Controller reads the Data Bus and then causes the Control Bus Decoder to enable Channel 0 of the 3 channel multiplexer. Channel 0 places the closed-switch row-coordinate data (0 through 15) onto the Data Bus. The Controller again reads the Data Bus by generating an In strobe, the trailing edge of which is used to remove the keyboard transmit code from Control Bus B and to set a new-data flip-flop in the Keyboard Status Logic. This flip-flop is reset when the depressed switch is released. However, when set, it inhibits the Controller from reading a single switch depression more than once.

3-35. The Controller returns response data to the Keyboard after every accepted keyboard transmission. A series of instruction registers (A, B and C) store the response data and drive the appropriate tone generator or front panel LED's. Response data is presented to the registers via the Data Bus and is loaded into the

individual register as a series of 3 four-bit characters. Register A is enabled when the Controller places a Keyboard Receive Code (binary coded 8) on Control Bus B, and is loaded when the Out strobe occurs. On the trailing edge of the Out strobe the Control Bus B Decoder enables Register B and allows it to be loaded on the next Out strobe. Register C is loaded in a similar manner.

3-36. The +5V dc drive for the improper condition LED's is derived from the output of a 1.7 Hz oscillator located on the Keyboard Switch PCB Assembly. When any one of these LED's is activated (via register A) the oscillator causes it to flash.

3-37. Keyboard Memory PCB Assembly

3-38. The Keyboard Memory PCB Assembly is a Controller peripheral designed to function as a non-volatile memory for storing scan format, scan control, output control, and limit value data entered by the keyboard or the —17 Option if installed. This includes: fixed data, first channel, last channel, interval, single channel, monitor channel, and (when all-limit options are installed) limit values for limit addresses 1 through 30.

3-39. The simplified block diagram shown in Figure 3-5 identifies the functional logic contained on the Keyboard Memory PCB Assembly, and defines the major flow of data to, from, and within the pcb. Prior to initial turn-on, previously entered program data is stored in a series of RAM's and is maintained by a 5.9V lithium battery. The battery is switched into the circuit during the absence of the Power-On-Reset (POR) signal (high during power-on) as derived from the Power Supply PCB. When power is turned-on, the RAM memory is switched to operate from the unguarded +5V dc (line powered) power supply.

3-40. Memory is enabled for either read or write applications when both the Power-On-Reset signal from the power supply, and the Keyboard Memory (KBD MEM) signal from the Controller are present as Keyboard Memory PCB inputs. These signals are AND'ed to enable a series of tri-state drivers which normally isolate the RAM and prevent it from being read or written into.

3-41. After memory is enabled, read/write operations can be executed in a character-serial fashion. An eight-bit address bus, A0 through A7, is operated by the Controller and used to select a particular location within the RAM's. The upper four bits of this bus, A4 through A7, drive a 1-of-16 decoder to develop the individual IC memory addresses, while the lower four bits, A0 through A3, define the unique character (word) location within the addressed IC. Data present in the addressed memory location is placed onto the Output Bus (O1 through O4) and, if desired, can be read by the Controller. If a word is

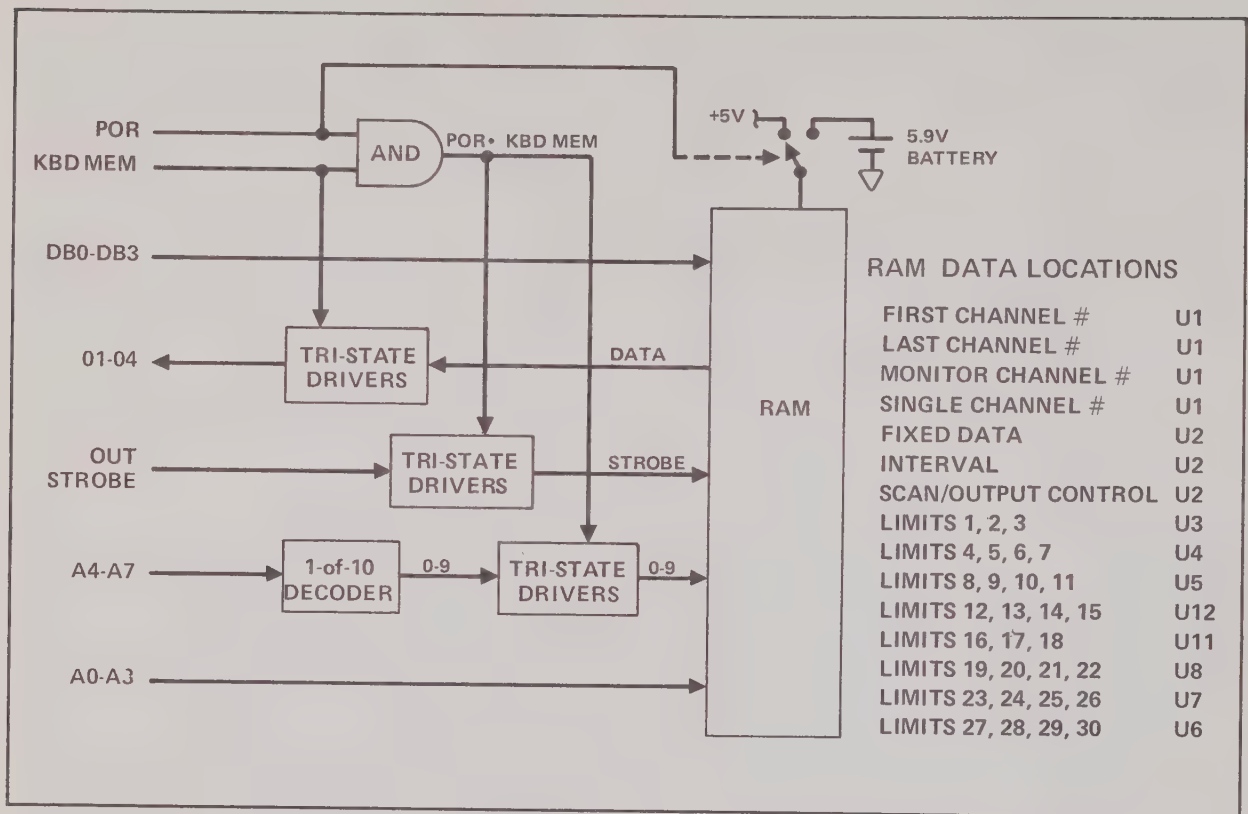


Figure 3-5. Keyboard Memory, Simplified Block Diagram

to be written into the addressed location, the Controller places the new word onto the Data Bus (DB0 through DB3) and then issues a Out strobe.

3-42. Mode Switch PCB Assembly

3-43. The Mode Switch PCB Assembly, as shown in Figure 3-6, operates as a controller peripheral and is capable of both transmitting and receiving data via the Data Bus. In the transmit mode, it provides the Controller with SCAN CONTROL and OUTPUT CONTROL switch-setting information. In the receive mode it accepts and stores numeric decade information from the Controller for use in driving the front panel display. The required operating mode is enabled via address data placed on Control Bus A and is executed under the direction of control signals received from the Controller.

3-44. In the transmit mode of operation the Mode Switch PCB Assembly scans the individual settings of the SCAN CONTROL and OUTPUT CONTROL switches and places the position information (depressed or out) onto the Data Bus for use by the Controller. Transmit mode operation begins when the Controller places a binary coded 8 on Control Bus A. This code is detected by the Control Bus Decoder on the Mode Switch PCB and is

used to enable a three-bit Multiplexer Address Control counter. The counter is sequenced by subsequent In strobe pulses from the Controller, and is used to sequentially address each channel of a three channel (four-bit per channel) multiplexer. Each channel of multiplexed data contains the switch position information for 4 of the 12 CONTROL switch settings. This data is presented to the Data Bus on the leading edge of the In strobe, and is assimilated by the Controller on the trailing edge. At the end of the third In strobe all 12 CONTROL switch settings have been transmitted and the Controller removes the address code from Control Bus A. This isolates the Mode Switch PCB from the Data Bus and, thus, the Controller.

3-45. In the receive mode of operation the Mode Switch PCB receives updated display information from the Controller (via the Data Bus) and stores it in a 4 x 16 bit RAM. Receive mode operation begins when the Controller places a binary coded 9 code on Control Bus A. As a direct result of the address code, the RAM address counter is preset to binary coded 11 output (via the RAM control logic) and the front panel display is blanked by a high BI level generated by the display blanking circuit. On the trailing edge of the next Sync pulse the RAM control logic is conditioned to respond to the Controller generated Out strobe. A valid display

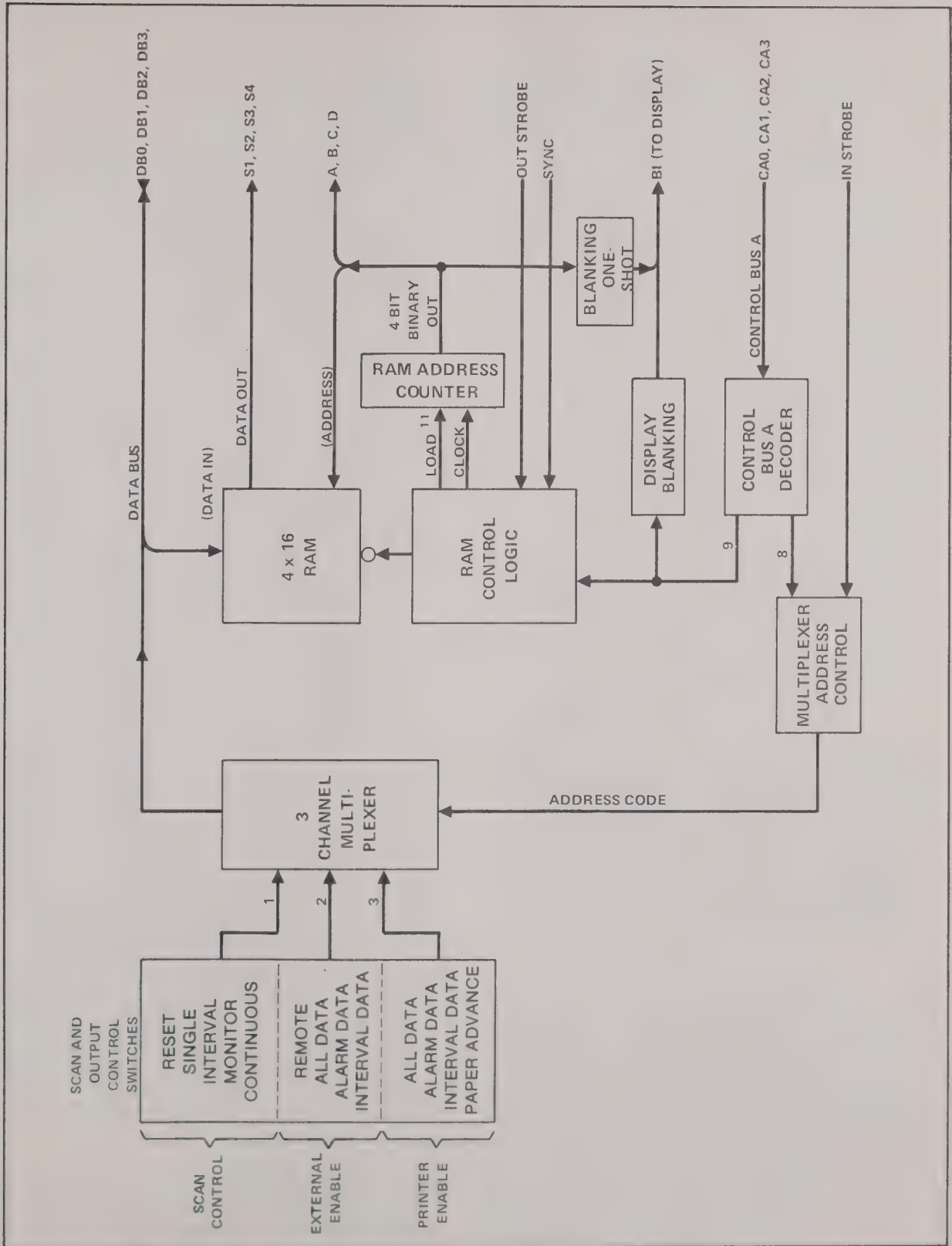


Figure 3-6. Mode Switch, Simplified Block Diagram

character preceeds each Out strobe and is placed on the Data Bus by the Controller. On the leading edge of the first Out strobe the RAM's write enable input is pulled low and the Data Bus character is entered into the binary coded 11 RAM location as defined by the RAM address counter. On the trailing edge of the Out strobe the counter is decremented to 10 and new data is solicited from the Controller. The remaining 11 characters are similarly written into memory by the Controller. After all 12 characters of display data have been written, the Controller terminates the receive mode by removing the binary coded 9 code from Control Bus A.

3-46. When the Mode Switch PCB is not operating in the receive mode the Sync pulse causes the RAM control logic to continuously cycle and, thereby, address the RAM locations. As each location is addressed, its stored four-bit character is presented to the Display PCB via data output lines S1, S2, S3, and S4. Since the RAM does not output data via the Data Bus, transmit and RAM read operation are conducted simultaneously. However, receive and RAM read are mutually exclusive operations.

3-47. A blanking one-shot is used to blank the display if the counter stops running. This prevents the display segments (which are normally scanned) from drawing excessive current in a static situation.

3-48. Display PCB Assembly

3-49. The Display PCB Assembly, as shown in Figure 3-7, operates as an extension of the Mode Switch PCB Assembly. It provides a digital display of either date-and-time, measurement, or program data that has been processed by the Controller, and stored in the 4 x 16 bit RAM on the Mode Switch PCB Assembly. As the RAM locations are serially addressed and read, both the address and the stored data readings are presented to the Display PCB. Address data is received as inputs A, B, C, and D. Stored data is received as inputs S1, S2, S3 and S4.

3-50. The individual display digits are formed by nine 7-segment LED's. These LED's are driven in parallel by the output of a BCD-to-seven segment decoder whose input is taken directly from the Mode switch as S1, S2, S3 and S4. Each of the LED's is individually strobed in serial fashion, and allowed to respond to data present on the seven-line data bus. The strobe sequence is derived directly from the Mode Switch RAM Address counter (A, B, C, D), and each strobed LED is allowed to read the addressed character stored in the (Mode Switch PCB's) corresponding RAM location. Since the data is scanned very rapidly (Sync pulse frequency $\div$ 12), the display character appear to be continuously lit.

3-51. In addition to the nine numeric characters, the Data Display PCB also contains provisions for driving the polarity (minus only), annunciator (MILLIVOLTS, VOLTS, TEMPERATURE and DATE AND TIME), and decimal point LED's as stored in the RAM on the Mode Switch PCB. Annunciator data is read from the seven-line data bus as if it were a numeric character. However, polarity and decimal point data are not. When either of these two RAM locations are addressed (binary coded 0 or 11) the resultant strobe (from display column decoder) disables the BCD-to-seven segment decoder and enables the decimal point position decoder. Under these conditions the seven-line data bus is dead and data from the addressed RAM location is decoded by the decimal point position decoder. The appropriate decimal point location(s) and/or minus polarity LED's are driven by the output of the decimal point position decoder. Table 3-2 lists each of the display strobe lines decoded from the RAM address counter on the Mode Switch PCB, and indicates the data enabled during each display (strobe) period.

Table 3-2. Display LED Addresses and Functions

Strobe Code	LED Enable	LED Function
112	DS5, DS6, DS7, DS8	Decimal Points
102	CR18, CR19, CR20, CR21	Annunciators
92	DS4	Minus Sign
82	DS9	LSD
72	DS8	5th Digit
62	DS7	4th Digit
52	DS6	3rd Digit
42	DS5	2nd Digit
32	DS4	MSD
22	DS3	LSD
12	DS2	2nd Digit
02	DS1	MSD

3-52. Printer Drive PCB Assembly

3-53. The Printer Drive PCB Assembly, as shown in Figure 3-8, operates as a Controller peripheral, to interface the internal Seiko Model 102 print head with the Controller Data Bus. Both transmit and receive operating modes are employed in the printing operation. The transmit mode is used to solicit data from the Controller and to synchronize the Controller to the printers mechanical rotation. In the receive mode the Controller sends printer data to the Printer Drive PCB Assembly via the Data Bus. Data for all 16 columns is printed within the time required for one rotation of the printer drum.

3-54. The Printer is a free running device and (to print properly) requires that input data be synchronized with the mechanical rotation of its print drum. Print drum position information is generated by the print head in the form of a Reset pulse and a series of 13

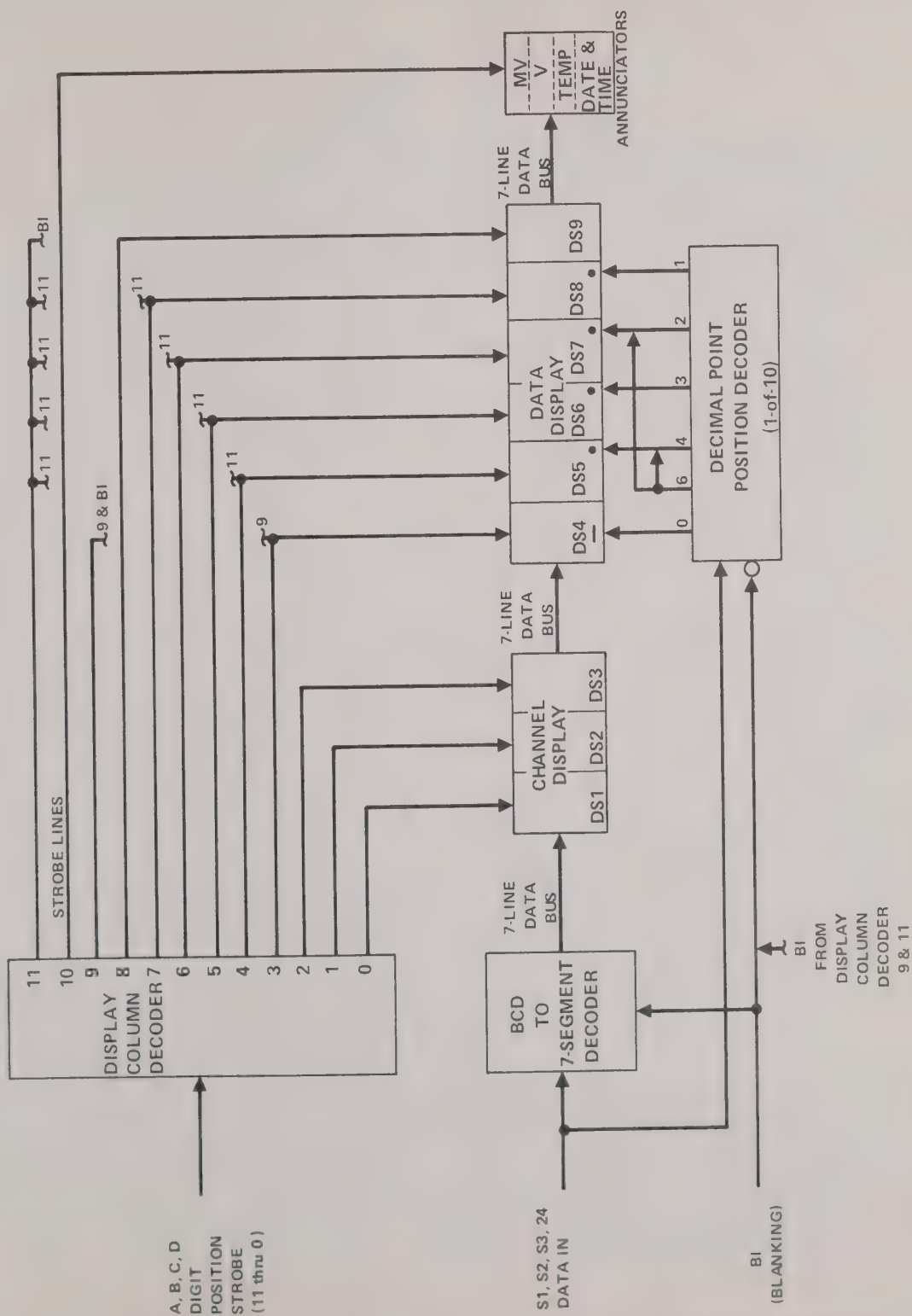


Figure 3-7. Display, Simplified Block Diagram

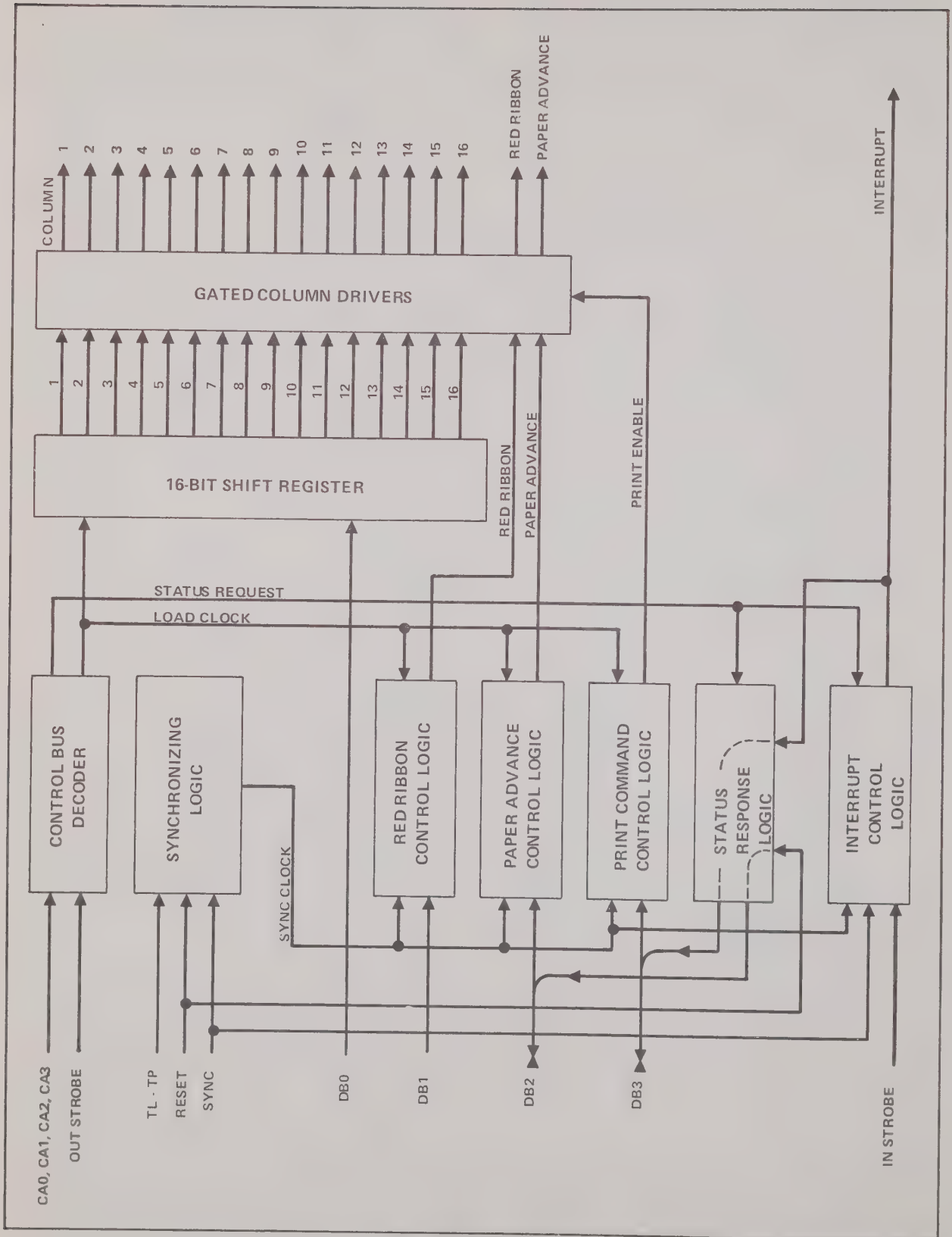


Figure 3-8. Printer Drive, Simplified Block Diagram

TL-TP pulses. Reset is generated once for every print drum revolution and indicates that row 0 is positioned under the 16-column print hammers. TL-TP pulses are generated as each of the 13 possible data rows (0 through 12) are positioned beneath the print hammers. Therefore, for each print drum revolution, 1 Reset pulse is generated and 13 TL-TP pulses are generated.

3-55. The TL-TP pulses from the printer are used by the Printer Drive PCB to synchronize the system clock (Sync) with the printer's drum position. Since the Sync pulse frequency is much higher than the TL-TP frequency, synchronization is accomplished by a coincidence detector and does not require a change in the drum rotation or system clock frequency. When either a Reset or a TL-TP pulse are detected, a pulse is generated by the synchronizing logic. This pulse arms the interrupt control logic to enable the next Sync pulse to generate an Interrupt to the Controller and, thereby, indicate that the printer's drum is in position to receive data.

3-56. In response to the Interrupt, the Controller interrogates the status of the three possible interrupt peripherals to determine which generated the Interrupt signal. When the Printer Drive status is requested (by a binary coded 13 on Control Bus A) it responds by placing the Reset and TL-TP signal levels onto the Data Bus (via status response logic) as bits DB2 and DB3, respectively, thus, confirming that it initiated the Interrupt. When the Controller generates the next In strobe, it reads the confirming interrupt status code (binary coded 12) and then removes the status interrogation code from Control Bus A. As the status request line from the control bus decoder goes low it resets the interrupt control logic and returns the Interrupt to a high level.

3-57. If the Controller is ready to supply data to the Printer Drive PCB when the Interrupt line returns high, it places a binary coded 5 onto Control Bus A. The control bus decoder detects this code and enables the 16 subsequent Out strobes from the Controller to be accepted as a series of 16 Load clocks on the Printer Drive PCB Assembly. As each Load clock is accepted, the bit-serial data on DB0 is loaded into a 16-bit shift register. This stored data determines which print hammers, if any, will be activated while row 0 of the printer drum is under the print hammers. As the 16th data bit is presented to the shift register, Red Ribbon, Paper Advance, and Print Command data are received on DB1, DB2, and DB3, respectively. The subsequent Load clock shifts the last data bit into the 16-bit shift register, enters ribbon color data into the red ribbon control logic, and enters paper advance information into the paper advance control logic. On the trailing edge of the Load clock the print command control logic generates a Print Enable signal. This signal enables the gated column drivers (Tri State drivers) to energize the

appropriate print hammers and, thereby, print row 0 characters in the selected columns. The Printer also responds to the red ribbon and paper advance commands, when present.

3-58. As the print drum continues to rotate, row 1 data is loaded into the shift register and the appropriate print hammer are energized. The sequence is performed a total of 13 times (once for each row on the printer drum) to complete a single print sequence. After the 13th Print Enable is derived from the Out strobe, the Controller terminates the sequence by removing the printer receive code (binary coded 5) from Control Bus A.

3-59. Power Supply PCB Assembly

3-60. The Power Supply PCB Assembly, as shown in Figure 3-9, provides the operating voltages for the data logger and a full complement of options. It also provides the 1-second time interval marker (TIM) and the Power-On-Reset (POR) signal. TIM is used by the Controller to update date and time. POR is used to initialize the entire data logger when power is turned on or when a power interruption occurs.

3-61. Input power for the power supply is derived from a 115/230V ac power transformer with four secondary windings. Transformer line-power requirements (115/230V ac) are switch selectable through a switch mounted on the Power Supply PCB. Output windings are separated into two pairs by a transformer shield. Isolation between the pairs is maintained on both the Power Supply PCB and the data logger by including the shield as part of the data loggers guard circuit. As a result the data loggers operating voltages are classified as guarded and unguarded. Guarded voltages include +21 and -21V dc unregulated, and +5V dc regulated. Unguarded supplies include +5V dc, +16V dc, and -10V dc; all of which are regulated and overload protected. The 1-second time base circuitry and the Power-On-Reset circuit are contained in the unguarded section of the power supply.

3-62. Conventional regulating techniques are used in both sections of the power supply. No voltage adjustments are required or included in the guarded section of the supply. In the unguarded section the -10V dc output serves as a reference voltage for both the +5 and +16V dc regulators. As a result, a single adjustment is provided for the -10V dc supply. When the -10V dc is calibrated the +5 and +16V dc supplies are automatically calibrated.

3-63. The 1-second time marker circuit consists of a switch selectable divide-by-50 or divide-by-60 IC whose input clock is derived from the ac voltage present at one of the transformer's secondary windings. When the IC is

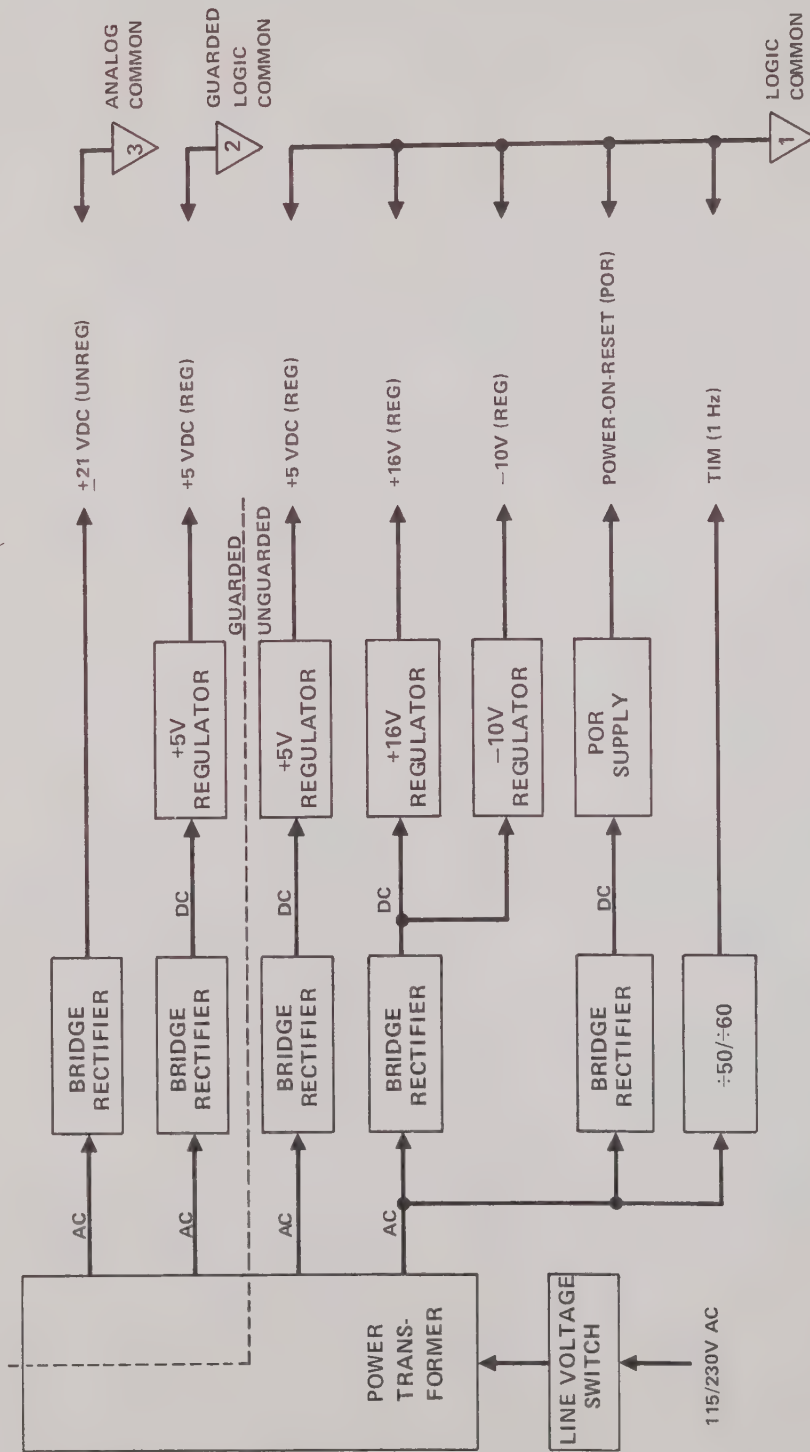


Figure 3-9. Power Supply, Simplified Block Diagram

set to divide by the actual line frequency (50 or 60 Hz) it generates a 1 Hz pulse as an output. The pulse is buffered and provided as a power supply output signal (TIM) for use by the Controller for updating date and time entries.

3-64. The Power-On-Reset (POR) signal serves as a reset command to initialize the system when power is initially turned-on, or when line power is restored after a power failure. POR is generated by a fast-acting unregulated supply whose output is normally low during power off. When line power is initially applied, POR remains low for approximately 600 ms (reset period) and then goes high (+5V dc). The signal is adequately buffered for use in resetting all data logger logic.

3-65. Range and Function Memory PCB Assembly

3-66. The Range and Function Memory PCB Assembly is a Controller peripheral designed to operate as a non-volatile memory for storing the programmed range/function and limit address (A and B) for each channel controlled by the data logger.

3-67. The normally volatile RAM's are made non-volatile by supplementing the unguarded +16V dc power supply with a 5.9V lithium battery. If the system power fails or is turned off, the battery is switched into service and maintains the data in memory. When power is restored the batteries are effectively removed from the circuit and the unguarded +16V dc power supply resumes the burden of supplying operating power to the RAM's. Under normal operating conditions battery life is five years, minimum.

3-68. The Range and Function Memory PCB Assembly, as shown in Figure 3-10, is capable of recognizing and responding to any one of seven control codes which appear on Control Bus B. These include one memory-address code (Channel Address Receive), three read-memory codes (transmit) and three write-into-memory codes (receive). (See Table 3-1 for a complete list of Control Bus Codes.) A memory address code always precedes a read or write operation and is used to allow the Controller to specify a particular memory location (channel) via the Data Bus. After the memory is addressed, the Controller specifies either the read or write function (via the Control Bus) and the type of data involved, i.e., range and function, limit A address, or limit B address. The next Sync pulse from the Controller allows the pcb assembly to initiate an internally clocked

sequence which complies with the code present on the Control Bus. Clock pulses for these sequences are derived from a 165 kHz, 2-phase clock generator which is an integral part of the Range and Function Memory PCB Assembly.

3-69. The memory address sequence is initiated when the Controller places a binary coded 4, onto Control Bus B. The code is detected by a control-bus decoder on the Range and Function Memory PCB, and is used to enable a series of four 2-bit shift registers. Address data is presented to the registers, via the Data Bus, as two 4-bit characters. Each character is loaded into the registers by accompanying Out Strobe pulses from the Controller. After the second address character is entered, the Controller removes the binary coded 4 from the Control Bus and, thereby, terminates the memory address sequence.

3-70. Stored address data operates in conjunction with control bus data to address a particular memory location for read and write sequences. The first seven bits of stored address data (A2-A8) are combined with the outputs (A0 and A1) of a two-bit binary counter to provide a nine-bit binary address code (512 individual addresses) to each of the six possible RAM's which comprise the program memory. The eighth bit of address data (A9) is combined with two bits of control bus data (CB0 and CB1) at the RAM enable decoder to define which one of the six RAM locations will be enabled during a read or write sequence. Control bus data CB0 and CB1 define one-of-three program functions: range and function data (01), limit A address (10) and Limit B address (11).

3-71. Both the read and write sequences begin in a similar manner. First, either a read code (binary coded 1, 2 or 3) or a write code (binary coded 5, 6 or 7) is placed onto Control Bus B by the Controller. Then bits 1, 2 and 8 of this code (CB0, CB1 and CB3) are analyzed by the control bus decoder to ensure that the following conditions are met: bit 8 (CB3) is low and either or both bits 1 and 2 (CB0 and CB1) are high. If these conditions exist, the leading edge of the next Sync pulse (from the Controller) causes the decoder to enable (E1) the read/write portion of the control logic. See write timing diagram in Figure 3-11). This in turn, allows the control logic to analyze the state of the 4-bit (CB2) which is high during the presence of a write code at the control bus, and low for a read code. If a write code is detected, the remainder of the sequence is executed as a write sequence. Conversely, a read sequence is executed if CB2 is low.

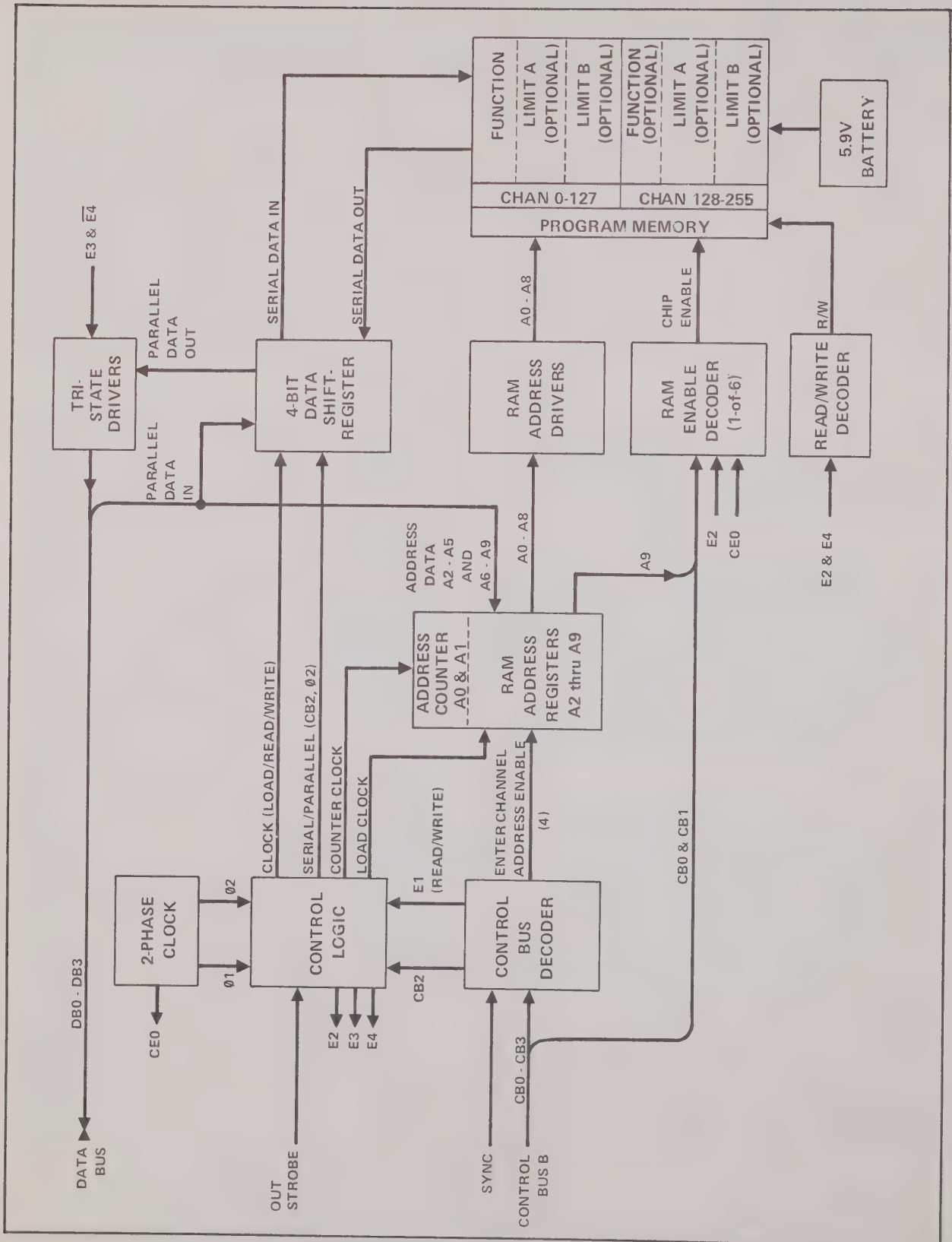


Figure 3-10. Range and Function Memory, Simplified Block Diagram

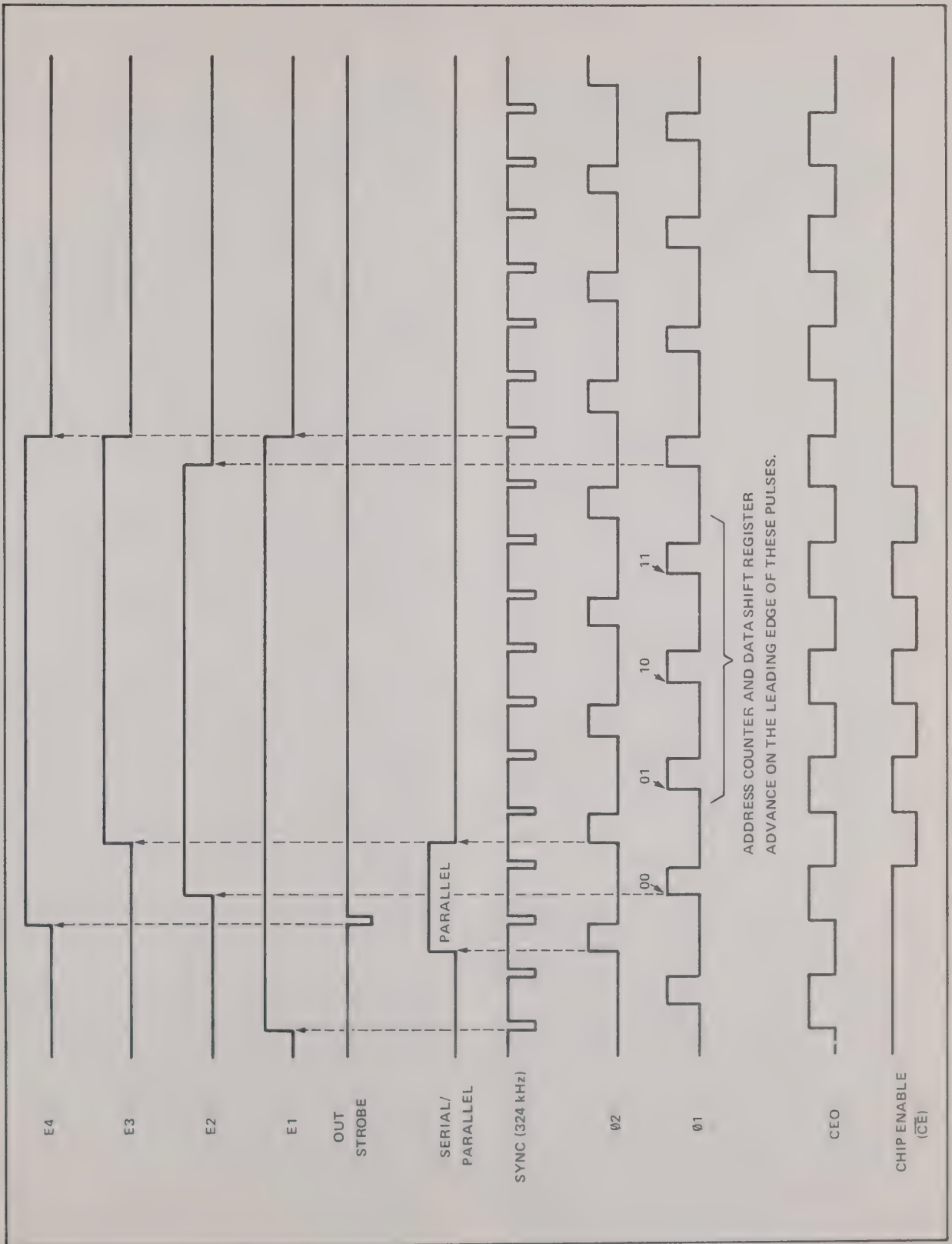


Figure 3-11. Range and Function Memory Write Sequence Timing Diagram

3-72. When a write sequence is indicated (i.e., both E1 and CB2 are high), the leading edge of the next ϕ_2 clock causes the Control Logic to generate a parallel mode command to the 4-bit data shift register. On the leading edge of the next Out strobe from the Controller, the Control Logic generates an E4 (enable write mode) output and a load clock. The load clock enters parallel data (DB0-DB3) from the Data Bus (as supplied by the Controller) into the 4-bit data shift register. With E4 high the Control Logic allows the leading-edge of the next ϕ_1 clock to generate a high E2 output. When both E2 and E4 are high the following circuits are affected: the two-bit counter (A0 and A1) in the RAM address register is enabled, the read/write decoder generates a write enable input to the program memory, and the control logic prepares to generate an E3 output, as well as a serial mode command (to the 4-bit data shift register). On the trailing edge of the ϕ_1 clock, CE0 (Chip Enable) goes low causing the first bit of data (DB0) in the four bit data shift register to be written into the addressed memory location. While CE0 is still low the leading edge of the ϕ_2 clock pulse occurs. This causes the E3 output to go high and the serial mode command to the 4-bit data shift register to be initiated. On the leading edge of each of the next three ϕ_1 clock pulses both the 4-bit data shift register and the address counter are incremented. Thus, as CE0 makes its negative transition each of the remaining three bits of input data are written into consecutive address locations in the program memory. When the address counter achieves a binary count of 3(11) is causes the leading edge of the next ϕ_1 clock pulse to reset the E2 output. This effectively ends the write sequence by inhibiting subsequent circuit reactions to the 2-phase clock outputs (ϕ_1 , ϕ_2 , and CE0). When the Controller removes the write code from the Control Bus the leading edge of the next Sync pulse resets the E1 output which clears the remainder of the control logic.

3-73. When a read sequence is indicated (i.e., E1 is high and CB2 is low), outputs E2 and E3 are sequentially clocked to the high state as shown in Figure 3-12. Notice that throughout the sequence, output E4 remains continuously low. This inaction on the part of E4 distinguishes the read sequence from the write sequence by enabling the following events: the ϕ_2 clock to selected as the read clock is serially shift RAM data into the 4-bit data shift register, the tri-state drivers are enabled for the duration of the E3 output to place parallel read data from the data shift register onto the data bus, the RAM's read/write inputs are commanded to read. As a result, when the chip enable signal ($\overline{CE}$) goes low, the data from the addressed memory location appears on the program memory's serial data output line. On the leading edge of the ϕ_2 clock the data is shifted into the data shift register. Chip enable ($\overline{CE}$) returns high and is followed by a ϕ_1 clock which advances the two-bit address counter. This

read cycle is repeated until the full four-bit word has been transferred from memory into the data shift register. At that time the address counter has reached a count of binary coded 3. This allows the following ϕ_1 clock to reset the E2 output low. The read sequence is then terminated on the leading edge of the next Sync pulse (i.e., outputs E1 and E3 are returned to their low state).

3-74. Guard Crossing PCB Assembly

3-75. The Guard Crossing PCB Assembly operates in conjunction with either the General Purpose A/D Converter (Option —09) or the High Performance A/D Converter (Option —10) to provide the data logger with guarded, programmable, a/d voltage-measurement capability. Functions performed by the Guard Crossing PCB in this operation include: electrical isolation of the guarded input section of the data logger from the unguarded digital control section, and digital control for the analog half of the dual-slope a/d converter (i.e., a/d control logic, crystal controlled clock, and main counter string). The theory of operation given herein describes the isolation and digital I/O functions performed by the Guard Crossing PCB Assembly, but does not include the theory of operation for the dual-slope a/d conversion process. This is described in detail in Section 6 of this manual under the a/d converter options —09 and —10, as applicable.

3-76. The Guard Crossing PCB Assembly, as shown in Figure 3-13, operates as a Controller peripheral and is capable of both receiving and transmitting data via the Data Bus. In the receive mode, channel and range programming data is accepted from the Controller, transferred across the guard crossing, and presented to the a/d converter. In the transmit mode, status or measurement data from the digital section of the a/d converter is transferred across the guard and presented to the Controller. The required operating mode is enabled when the appropriate address code is present on Control Bus A, and is executed under the direction of control signals received from the Controller.

3-77. The receive mode is enabled when the Controller places a binary coded 2 on Control Bus A. Input data from the Controller is received in character-serial format (four 4-bit characters) on the Data Bus (DB0 through DB3) and temporarily entered into storage in the channel and range latch by the Out strobe. Once stored, the character is optically transmitted across the guard, buffered, and presented to the a/d converter option (—09 or —10) as channel and range control data. As each character crosses the guard, it is followed by a 10 μ s Receive clock. The clock is derived from the Out strobe and is generated by the receive clock logic. On the guarded side of the pcb, the Receive clock increments a four-bit shift register, the output of which, addresses

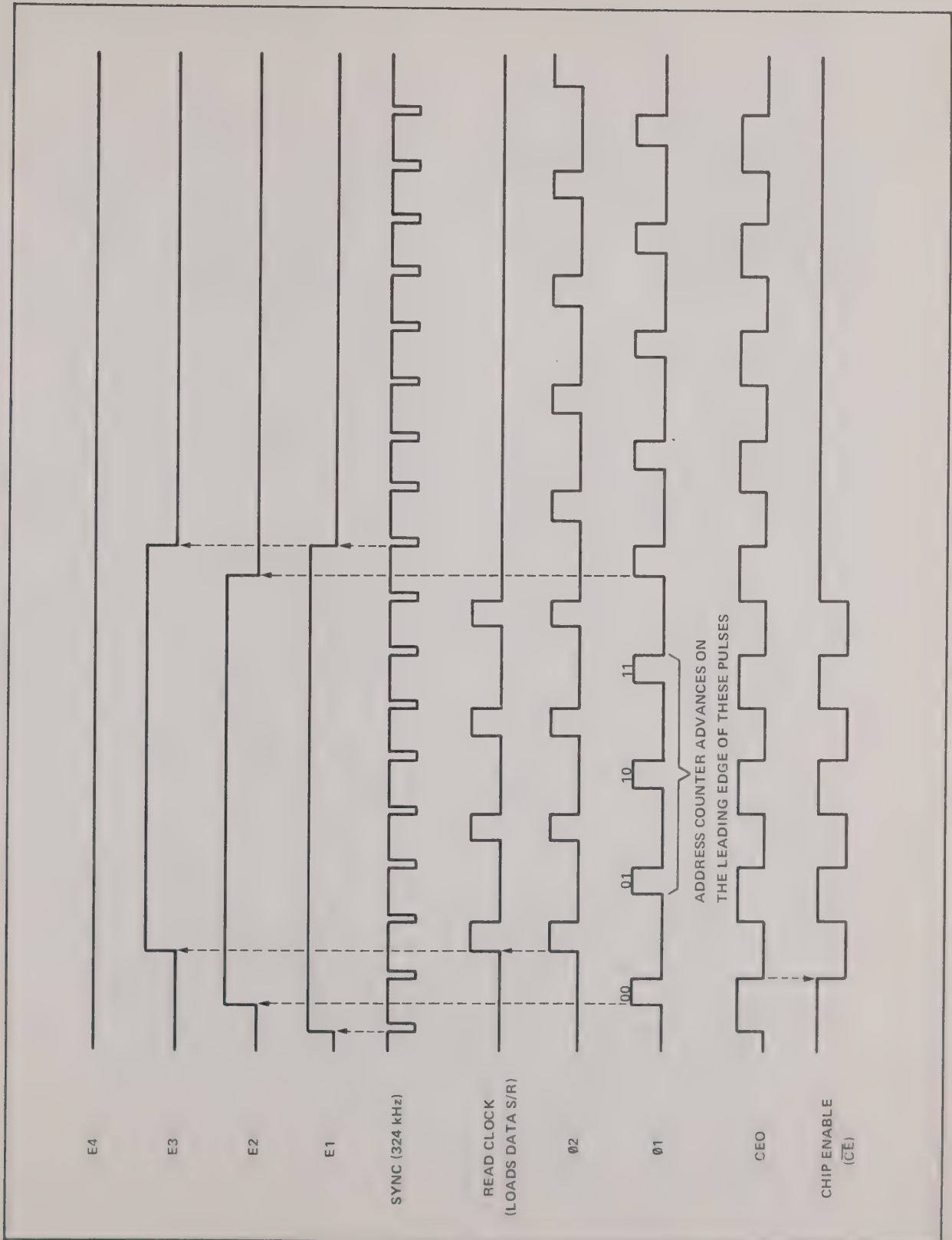


Figure 3-12. Range and Function Memory Read Sequence Timing Diagram

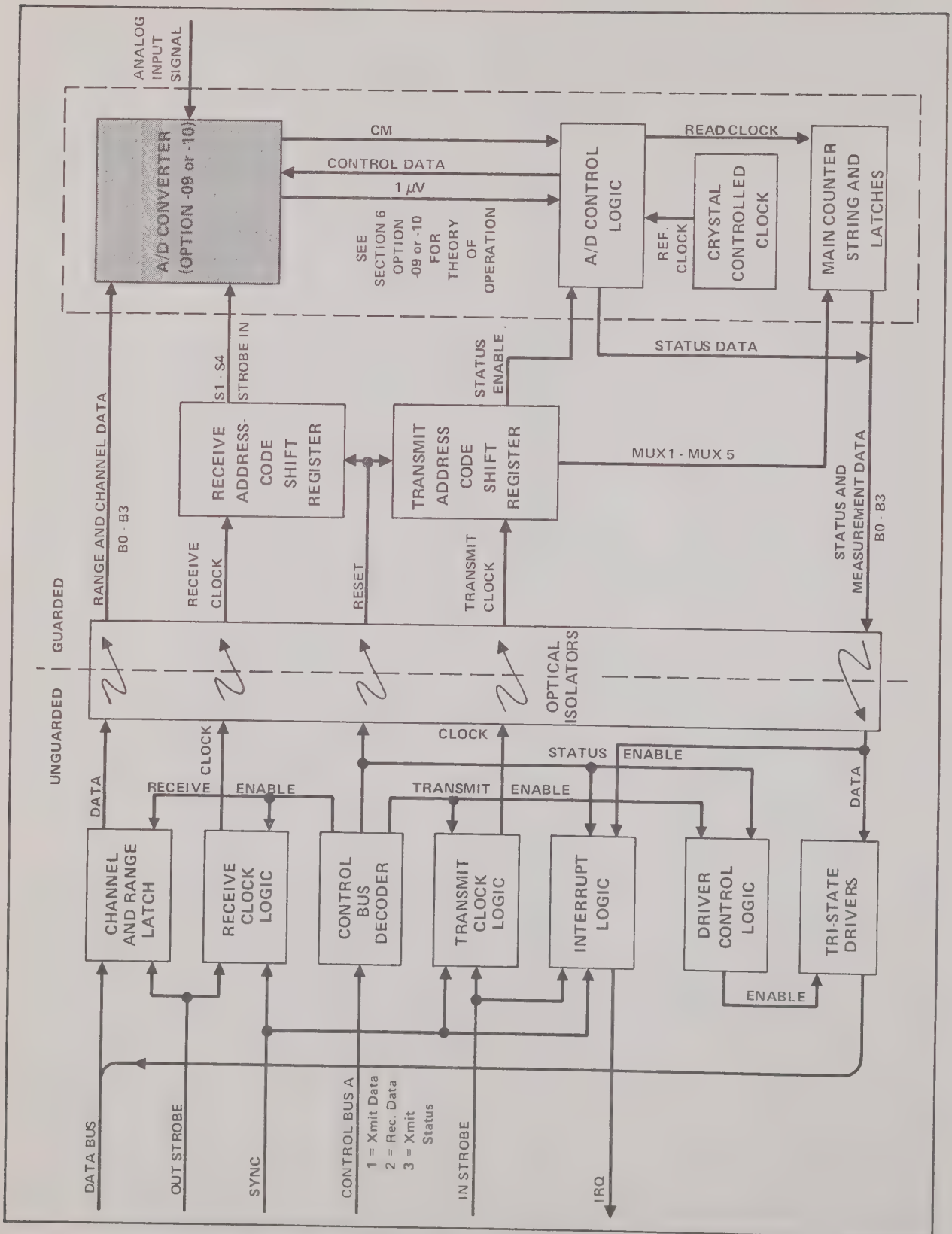


Figure 3-13. Guard Crossing, Simplified Block Diagram

range (S1) and channel storage (S2, S3 and S4) locations on the a/d converter option. Data entered into these locations define the channel to be measured and the measurement range to be used.

3-78. The transmit status mode is enabled when the Controller places a binary coded 3 on Control Bus A. During the presence of this code, the control bus decoder generates a Status Enable signal which is used to perform three separate functions. First, it is transmitted across the guard where it is used to reset (initialize) both the transmit and receive address code shift registers. Second, it enables the tri-state drivers which allow transmitted data to be placed onto the Data Bus. Third, it allows the next In strobe to reset the Interrupt Logic and, thereby, clear the interrupt request line (IRQ).

3-79. When the tri-state drives are enabled and the two address code registers are reset, status information is allowed to appear on the Data Bus as a single four-bit output character. Three separate characters are employed to indicate each of the following status conditions: measurement data ready, new channel and function data required for next measurement, and 1 μ V signal. All three of these codes are derived from the a/d control logic portion of the Guard Crossing. The new-data-required and data-ready status conditions are keyed to the beginning and end, respectively, of each measurement cycle. The 1 μ V signal is transmitted only once (during the initial power-on) and is used to inform the Controller of the type of A/D Converter installed (General Purpose A/D Converter, —09; or the High Performance A/D Converter, —10).

3-80. When the a/d converter completes a measurement cycle it notifies the Controller by setting the Interrupt Logic and pulling the IRQ line low. The Controller responds by serially interrogating the status of the Printer Drive, the output options, and the Guard Crossing PCB Assemblies, to determine which of the three random responding units pulled the IRQ line low. When the Guard Crossing PCB is interrogated, it indicates that the measurement data is ready to be transmitted. The Controller responds by terminating the status transmit mode and enabling the transmit data mode.

3-81. The transmit data mode is enabled when the Controller places a binary coded 1 code on Control Bus A. While the code is present on the Control Bus, it causes the control bus decoder to generate a Transmit Enable signal. This signal, in turn, enables the tri-state drivers and the transmit clock logic. The next In strobe from the Controller is passed through the transmit clock logic, coupled across the guard and used to set the first position of a five-bit shift register. Each subsequent In strobe is used to advance the shift register position and, thereby, sequentially address a five-channel multiplexer (main counter string and latches) in which measurement data is stored (MUX1-MUX5). As each channel of data is addressed (LSD first, MSD last), it is placed onto the guarded side of the data bus (B0 through B3), transmitted across the guard, and presented to the Data Bus through the enabled tri-state drivers. Each character is read into the Controller on the trailing edge of the In strobe.

Section 4

Maintenance

WARNING!

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

4-1. INTRODUCTION

4-2. This section of the manual contains maintenance information for the Model 2240B Data Logger. This includes service information, general maintenance, and a performance test. The performance test is recommended as an acceptance test when the instrument is first received, and later as a preventive maintenance tool to verify proper instrument operation, when necessary. A calibration cycle of 1 year is recommended to maintain the 2240B within the 1-year specifications. If the 90-day specifications are to be maintained, a 90-day calibration cycle is recommended. Table 4-1 lists the recommended test equipment necessary to execute the performance test and calibration procedures. If the specified equipment is not available, alternate equipment having equivalent specifications may be substituted.

Table 4-1. Recommended Test Equipment

INSTRUMENT	RECOMMENDED MODEL
DC Voltage Calibrator	Fluke 343A
DVM	Fluke 8000A
Low Level Scanner	Fluke Option —06
Input Connector	Fluke Option —07 or —08

4-3. SERVICE INFORMATION

4-4. The 2240B is warranted for a period of 1 year upon delivery to the original purchase. The WARRANTY is given on the back of the title page located in the front of the manual.

4-5. Factory authorized calibration and service for each Fluke product is available at various worldwide locations. A complete list of these service centers is included with the WARRANTY. Shipping information is given in Section 2 of this manual. If requested, an estimate will be provided to the customer before any repair work is begun on instruments that are beyond the warranty period.

4-6. GENERAL MAINTENANCE

4-7. Access Information

WARNING

LETHAL VOLTAGES MAY BE PRESENT AT THE LINE POWER INPUT CONNECTOR AND THE POWER SUPPLY PCB ASSEMBLY WHEN THE 2240B IS CONNECTED TO LINE POWER. LETHAL COMMON MODE VOLTAGES MAY ALSO BE PRESENT AT THE SCANNER INPUT CONNECTORS AND SCANNERS PCB'S EVEN THOUGH THE LINE POWER CORD IS DISCONNECTED.

4-8. CALIBRATION ADJUSTMENTS

4-9. All calibration adjustments and all plug-in options within the data logger can be accessed for maintenance purposes by removing the top dust cover and the two inner covers located in the top rear of the instrument. Six Phillips head screws hold the top dust cover in place.

4-10. SEIKO MODEL 102 PRINTER HEAD

4-11. Use the following procedure to remove the printer head from the 2240B:

- a. Remove the top dust cover from the 2240B.
- b. Locate the hinges for the printer's front panel assembly and, with the panel closed, apply pressure, using a thumb or finger, to the rear of one of the hinges. The hinge will snap apart.
- c. Using a lateral motion, separate the other hinge and remove the printer's front panel.
- d. Disconnect the printer's cable and connector assembly from the Printer Driver PCB. (The cable is located at the bottom of the printer bulkhead.)
- e. Remove the four large mounting screws at the rear of the printer bulkhead. Support the printer with one hand while removing these screws. (The use of an offset Phillips-head screwdriver is suggested.)
- f. Fully extend the paper drawer and work the top of the printer through the front panel opening. Tilt the printer forward and rest it on the paper drawer.
- g. Push the cable through the bulkhead bushing and cable clamp to obtain about 4 to 5-inches of free cable at the printer.
- h. Remove the printer's cable clamp and cable bushing from the printer bulkhead.
- i. Remove the cable from the bushing slot and slide both the cable and connector past the extended printer drawer.
- j. Logically reverse this procedure to install the printer head.

4-12. Cleaning

4-13. Clean the Model 2240B periodically to remove dust, grease and other contamination. Separate

procedures are given below for cleaning the Seiko Model 102 Printer Head, and the 2240B cables and pcb's.

4-14. SEIKO MODEL 102 PRINTER HEAD

4-15. The printer should be cleaned after using 10 packs of paper or every 90-days. Use the following procedure:

- a. Remove the printer head from the chassis using the procedure given in paragraph 4-10.
- b. Use a brush or vacuum cleaner to remove dust and other clinging particles.
- c. Clean the face of the print drum using a hard bristle brush.
- d. Use alcohol or benzine to remove grease and grime from the printer.

CAUTION

The use of thinner, tri-chloroethelene, ketone, etc., may cause damage to plastic parts on the printer.

4-16. CABLE AND PCB'S

4-17. Use the following procedure to clean the interface cables and pcb's used with the data logger.

- a. Clean the cables with a soft cloth dampened with a mild solution of detergent and water.
- b. Clean the surface of the pcb's using clean dry air at low pressure (≤ 20 psi). If grease is encountered, spray with Freon T.F. Degreaser and remove grime with clean, dry air at low pressure.

4-18. Lubrication

4-19. The Seiko Model 102 Printer should be lubricated every 6 months under normal use conditions and, if necessary, after cleaning. Refer to Figure 4-1 and apply the specified lubricant, O2 or G2, to the points indicated. Use a syringe for hard-to-reach lubrication points.

NOTE

The required lubricants, O2 and G2, can be purchased from: Itronics Lab., 381 Beach Rd. Burlingame, CA. 94010. Telephone: 415-342-6712.

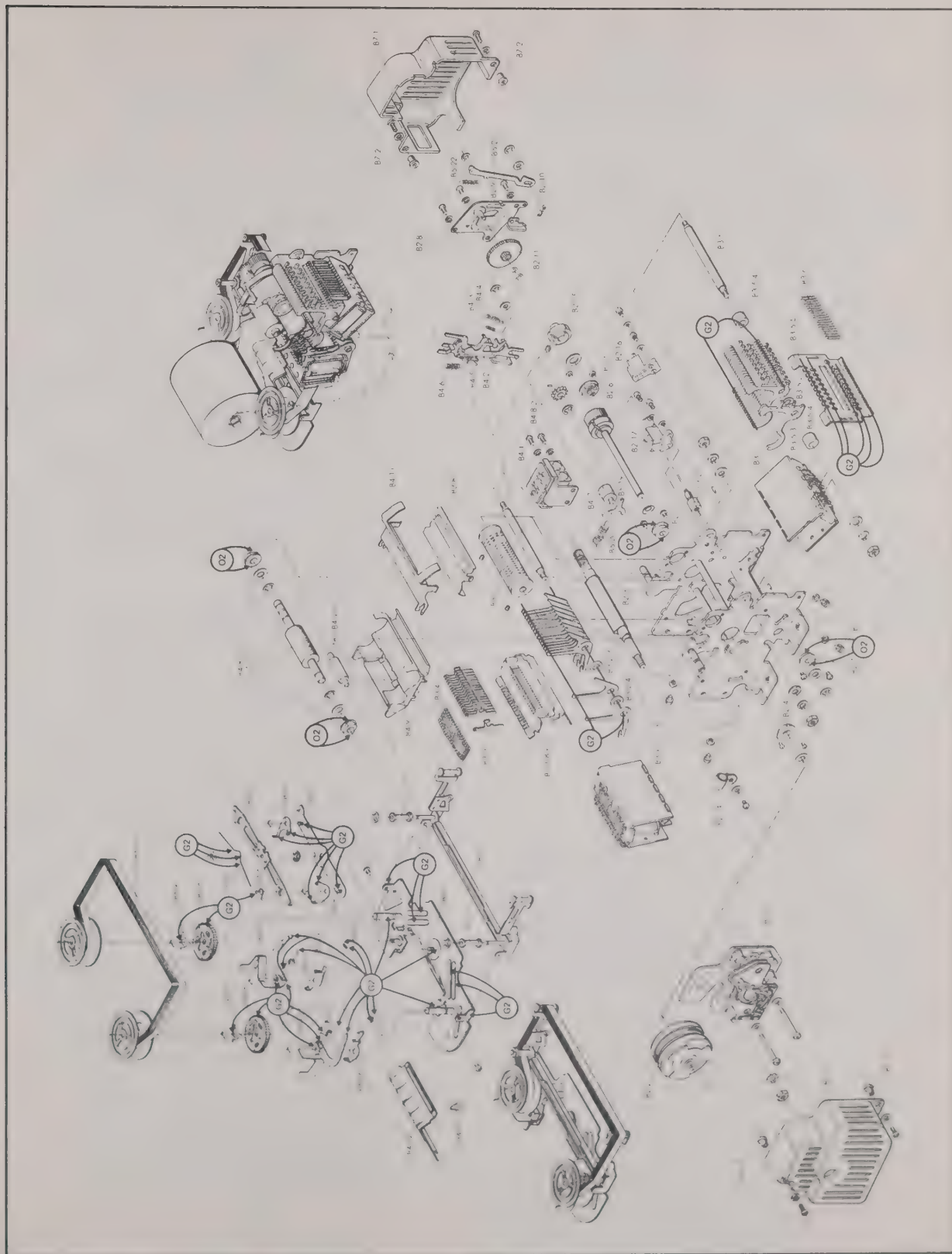


Figure 4-1. Lubrication Chart

4-20. Fuse Replacement

4-21. The power fuse is located on the rear panel of the data logger. If replacement is necessary, select the fuse rating according to the local line voltage as listed below:

WARNING

DISCONNECT THE UNIT FROM LINE POWER BEFORE ATTEMPTING FUSE REPLACEMENT.

1. 100V ac — 3/4A Slo Blo
2. 115V ac — 3/4A Slo-Blo
3. 230V ac — 3/8A Slo-Blo

NOTE

The fuse holder cap can be replaced with a metric cap (John Fluke P/N 424440) which will accept 5 mm x 20 mm fuses.

4-22. Service Tools

4-23. A special interface cable is required to execute the Performance Test given later in this section. The cable is fabricated using either of the available input connectors, (Option —07 or —08) and a length of 20 gauge insulated wire. The instructions necessary to fabricate the cable are given in Figure 4-2.

4-24. A set of PCB Extender Cables are available for servicing the plug-in pcb's contained in the data logger. The Extender Cables are available as accessories and are described in Section 6, Option and Accessory Information.

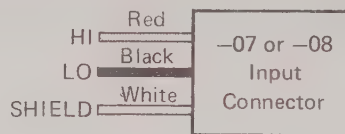
4-25. PERFORMANCE TEST

4-26. The performance test is designed to verify the overall operation of the 2240B, and is intended for use as an acceptance test and/or periodic maintenance check. The equipment used in the test is specified in Table 4-1. The entire test should be executed in the sequence given. If the 2240B fails any part of the performance test, corrective action is indicated. Troubleshooting information is given at the end of the this section.

4-27. Set-Up Procedure

4-28. Prior to executing the performance test complete the following set-up procedure:

- a. Install a Low Level Scanner (Option —06) in slot 0 (Channel 0-9) of the 2240B. The dust cover and the left-rear inner guard should be removed for the duration of the performance test.



Use the following procedure to prepare the above test cable:

1. Cut a 24-inch length of each of the following wires. Use insulated, 20 gauge, standard wire:
 - a. Red
 - b. Black
 - c. White
2. Refer to the connector decal for pin locations and connect the wires from step 1 to the following connector inputs:
 - a. Red wire to HI-0, HI-4 and HI-5
 - b. Black wire to LO-0, LO-4 and LO-5
 - c. White wire to SH-0, SH-4 and SH-5
3. Strip ½ inch of insulation from the free ends of the red, black and white wires, and tin the exposed wire.
4. Install the following jumpers on the input connector. Use bare copper hook-up wire:

a. LO-1 to HI-1	d. LO-6 to HI-6
b. LO-2 to HI-2	e. LO-7 to HI-7
c. LO-3 to HI-3	f. LO-8 to HI-8
	g. LO-9 to HI-9

Figure 4-2. 2240B Test Cable

- b. Set switch #2 on the A3 Controller PCB to OFF (Alarms Once).
- c. Attach the test cable described earlier under Service Tools to the scanner in slot 0.
- d. Connect the free end of the test cable to the output of the DC-Voltage Calibrator (Red to +, Black to -, and White to ground).
- e. Set the DC Voltage Calibrator for a 0V dc output.
- f. Energize the DC Voltage Calibrator.
- g. Press the RESET switch in the 2240's SCAN CONTROL group.
- h. Press the ALL DATA switch in the PRINTER ENABLE group. Release all other switches in the OUTPUT CONTROL group.

- i. Connect the 2240B to line power and set the Power switch to POWER ON. The DATA display should read 2240B 3 for ≈ 3 seconds and then begin to read elapsed time. The POWER FAILURE RE-ENTER TIME lamp in the TIME ENTRY group should begin to flash.

4-29. Display and Data Entry Test

4-30. Use the following procedure to check the operation of the 2240B display and Data Entry switches:

- a. Complete the Set-Up Procedure.
 - b. Press the FIXED DATA switch in the SCAN FORMAT group. All annunciators and the CHANNEL display should be out. The fixed data currently in memory should appear at the DATA display.
 - c. Using the DATA ENTRY keyboard, enter a series of six 1's. The DATA display should read 111111.
 - d. Press CLEAR ENTRY switch and enter six 2's on the keyboard. The DATA display should read 222222.
 - e. Press CLEAR ENTRY switch and repeat the previous step using a series of 3's, 4's, 5's, 6's, 7's, 8's, 9's and 0's. The entered data should appear on the DATA display.
 - f. Press the MONITOR CHANNEL switch in the SCAN FORMAT group. The monitor channel currently in memory should appear at the CHANNEL display.
 - g. Using the DATA ENTRY keyboard enter a series of three 1's. The CHANNEL display should read 111.
 - h. Press CLEAR ENTRY switch and enter three 2's on the keyboard. The CHANNEL display should read 222.
 - i. Press CLEAR ENTRY switch and repeat the previous step using a series of 3's, 4's, 5's, 6's, 7's, 8's, 9's and 0's. The entered data should appear on the CHANNEL display.
- a. Press the DAYS switch in the TIME ENTRY group. All annunciators and the DATA display should be out. The day code currently in memory should appear on the DAY (CHANNEL) display (000 if day code has not been entered since power was turned on).
 - b. Using the DATA ENTRY keyboard, enter 222 and press the ENTER/STEP switch. The DAY display should read 222 along with hours, minutes and seconds on the DATA display. The power failure LED should no longer flash.
 - c. Press the HR:MIN:SEC switch in the TIME ENTRY group. The DAY display should go out and the DATA display should go out and the DATA display should read the time-of-day currently in memory.
 - d. Using the DATA ENTRY keyboard, enter 235950. The entered data should appear on the DATA display as 23 hours, 59 minutes and 50 seconds.
 - e. Press the ENTER/STEP switch and observe the display. The clock should start running the instant the ENTER/STEP switch is pressed. When the clock makes the transition from 23:59:59 to 00:00:00 ensure that the DAY display changes from 222 to 223.
 - f. Press HR:MIN:SEC in the TIME ENTRY group and enter 489999 on the DATA ENTRY keyboard.
 - g. Press the ENTER/STEP switch while observing the display. The reading should change to 225 01:40:40 and begin counting.

4-33. Scan Format Test

4-34. Use the following procedure to check the operation of the SCAN FORMAT switches and the associated memory.

- a. Press the FIXED DATA switch in the SCAN FORMAT group.
- b. Using the DATA ENTRY keyboard, enter 123456 and press the ENTER/STEP switch.
- c. Press the FIRST CHANNEL switch in the SCAN FORMAT group. The first channel currently in memory will be displayed.
- d. Enter 0 on the DATA ENTRY keyboard and press the ENTER/STEP switch. The CHANNEL DISPLAY should read 000.

4-31. Date and Time Test

4-32. Use the following procedure to check the operation of the time-of-year clock.

- e. Press the LAST CHANNEL switch in the SCAN FORMAT group. The last channel currently in memory will be displayed.
 - f. Enter 59 on the DATA ENTRY keyboard and press the ENTER/STEP switch. The CHANNEL DISPLAY should read 059.
 - g. Press the INTERVAL HR:MIN:SEC switch in the SCAN FORMAT group. The time interval currently in memory will be displayed in HR:MIN:SEC on the DATA display.
 - h. Enter 10 on the DATA ENTRY keyboard and press the ENTER/STEP switch. The DATA DISPLAY should read 00.00.10.
 - i. Press the MONITOR CHANNEL switch in the SCAN FORMAT group. The CHANNEL display should read the monitor channel currently in memory.
 - j. Enter 5 on the DATA ENTRY keyboard and press the ENTER/STEP switch. The CHANNEL display should read 005.
 - k. Press the SINGLE CHANNEL switch in the DISPLAY CONTROL group. The single channel currently in memory will be displayed.
 - l. Enter 4 on the DATA ENTRY keyboard and then press the ENTER/STEP switch. The CHANNEL display should read 004.
 - m. Starting with FIXED DATA sequentially press each switch in the SCAN FORMAT group and ensure that the previously entered data is displayed.
 - n. Press the SINGLE CHANNEL switch in the DISPLAY CONTROL group and verify the presence of previously entered data.
 - o. Set the Power switch to POWER OFF for at least 1 minute and then set it to POWER ON. The POWER FAILURE RE-ENTER TIME lamp should begin to flash.
 - p. Repeat steps m. and n.
 - q. Reset the POWER FAILURE RE-ENTER TIME lamp by pressing the DAY or HR:MIN:SEC switch in the TIME ENTRY group and the ENTER/STEP switch on the DATA ENTRY keyboard.
- a. Press the PROGRAM LIST switch. The printer should print the date and time; interval in hours, minutes, and seconds; fixed data; the monitor channel; and all available limit addresses (30 max.) and their assigned values. This data is then followed by a list of all channels within the limits defined by the scan format. The assigned measurement function and scale is printed on the channel line. If limits data has been assigned to the channel, the limit address, high (>) or low (<) sense, and the limit value is printed on the line following the channel data. If a channel is programmed to skip, function, scale, and limits data will not accompany the channel number.
 - b. Press the ENABLE switch in the CHANNEL PROGRAMMING group and enter the number of the first channel listed by the printer. Press the ENTER/STEP switch. The ENTER FUNCTION lamp should light.
 - c. Press the SKIP switch on the DATA ENTRY keyboard and then press the ENTER/STEP switch.
 - d. Identify the next channel printed on the program list and enter it on the DATA ENTRY keyboard.

NOTE

When practical, use the ADVANCE ADDRESS switch to call up the next applicable channel.

- e. Press the REPEAT switch in the CHANNEL PROGRAMMING switch group.
- f. Repeat steps d and e of this procedure for all remaining channels listed by the printer.
- g. Press the PROGRAM LIST switch. Heading data, limits data and channel numbers will be printed. However, channel function data will not be printed.
- h. Press the ENABLE switch in the CHANNEL PROGRAMMING group and enter an address of 0.
- i. Press the ENTER/STEP switch. The ENTER FUNCTION lamp should light.
- j. Select the 4V function on the DATA ENTRY keyboard and press the ENTER/STEP switch.
- k. If the Limit Options are installed, press the SKIP and ENTER/STEP switches for both LIMIT A and LIMIT B. The CHANNEL ENTER ADDRESS lamp should light.

4-35. Channel Programming Test

- 4-36. Use the following procedure to check the operation of the Channel Programming circuits:

- l. Enter an address of 5 using the DATA ENTRY keyboard and press the ENTER/STEP switch.
- m. Sequentially press the REPEAT, ADVANCE ADDRESS, and the REPEAT switches.
- n. Call the following channel addresses using the DATA ENTRY and ENTER/STEP switches, and press the REPEAT switch after each is entered: 10, 15, 20, 25, 30, 35, 40, 45, 50, 55.
- o. Press the PROGRAM LIST switch. The standard heading and each of the programmed channels and their function should be printed.
- p. Set the Power switch to POWER OFF for 1 minute and then set it to POWER ON.
- q. Repeat step o. Program data should not change.

4-37. Scan Control Test

4-38. The following procedure checks the operation of the 2240B scan control logic and measurement circuitry:

NOTE

This procedure assumes that the data entered during the Scan Format and Channel Programming checks is still in memory.

- a. Adjust the calibrator for an output of 1.0000V dc.
- b. Press the SINGLE switch in the SCAN CONTROL group. The printer should record inputs of 1.0000V dc at channels 0, 4, and 5; and ≈ 0 V dc at all channels that have not been skipped.
- c. Press the STOP/RESET switch in the SCAN CONTROL group.
- d. Press LAST CHANNEL in the SCAN FORMAT group, then press 9 and ENTER/STEP on the DATA ENTRY keyboard.
- e. Set the DC Voltage Calibrator for an output of 2.0000V dc.
- f. Press the INTERVAL switch in the SCAN CONTROL group. The printer should record a 2.0000V dc reading for channels 0 and 5. The scan-cycle start should repeat itself at the programmed interval (10 sec).
- g. Press the MONITOR switch in the SCAN CONTROL group. The display should indicate a 2.0000V dc input to channel 5.
- h. Increase the calibrator output to 5.0V dc. The DATA display should read uuuuu to indicate the presence of an overrange voltage.

- i. Press the CONTINUOUS switch in the SCAN CONTROL group, and the ALL DATA switch in the PRINTER ENABLE group. The printer should print ;--:-V for both channels 0 and 5 to indicate the presence of an overrange voltage. The scan cycle should continue to repeat with a minimum time between the end of one cycle and the start of the next.
- j. Decrease the calibrator output to 3.0V dc.
- k. Press the SINGLE CHANNEL switch in the DISPLAY CONTROL group followed by ENTER/STEP. The display should indicate a 3.0000V dc input at channel 4.
- l. Press the STOP/RESET switch in the SCAN CONTROL group.

4-39. Output Control Test

4-40. Use the following procedure to check the operation of the OUTPUT CONTROL logic:

NOTE

This procedure assumes that the Scan Control Test has been completed and that the conditions existing at the end of that check are still present.

- a. Press the ALARM DATA switch in the PRINTER ENABLE group and release the ALL DATA switch.
- b. Press the INTERVAL switch in the SCAN CONTROL group. The display should indicate an overrange for both channels 0, 4, and 5, but the printer should not record data.
- c. Reduce the output of the voltage calibrator to 3.9000V dc. The display should indicate 3.9000 volts for both channels 0, 4, and 5, and the printer should not record data for either channel.
- d. Press the INTERVAL DATA switch in the PRINTER ENABLE section of the OUTPUT CONTROL group. The printer should record the displayed data for channels 0 and 5 each time a scan sequence occurs.
- e. Press the CONTINUOUS switch in the SCAN CONTROL group. The scan sequence should be continuously repeated, and data should be printed on the initial scan and every 10 seconds thereafter.
- f. Press the RESET switch in the SCAN CONTROL group.

4-41. Display Control Test

4-42. Use the following procedure to check the operation of the DISPLAY CONTROL group.

NOTE

This procedure assumes that the Output Control Test has been completed and that the conditions existing at the end of that test are still present.

- a. Release all switches in the PRINTER ENABLE section of the OUTPUT CONTROL group.
- b. Press the CONTINUOUS switch in the SCAN CONTROL group. The data logger should alternately display channels 0,4, and 5 and their associated voltage readings.
- c. Press the DATE AND TIME switch in the DISPLAY CONTROL logic. The display should read date and time. The clock should be running.
- d. Press the SINGLE CHANNEL switch in the DISPLAY CONTROL group followed by ENTER/STEP. The display should read channel 004 and its associated input voltage, (3.9000V).
- e. Press the ALL CHANNELS switch in the DISPLAY CONTROL group. The display should alternately display channels 0, 4, and 5 and their associated voltage readings.
- f. Press the RESET switch in the SCAN CONTROL group.

4-43. Limits Test

4-44. If the LIMIT A (1-15)/LIMIT B (16-30) Option(S) (—22) are installed, use the following procedure to perform a functional limit's check.

NOTE

This procedure assumes that the Display Control Test has been completed and that the conditions existing at the end of that test are still present.

- a. Set the calibrator output to 0V dc.
- b. Program and recall each of the available limits (1-15 and 16-30) using the following sense and value combinations: HI-1111, HI-2222, LO-4444, and LO-8888.
- c. Program channel 5 as follows:
 1. Channel Address = 5
 2. Function = 4V
 3. Limit Address A = 1
 4. Limit Address B = 16
- d. Program limit address 1 as follows:
 1. Limit Address = 1
 2. Enter Sense = HI
 3. Enter Value = 1248

- e. Program limit address 16 (if LIMIT B is installed) as follows:
 1. Limit Address = 16
 2. Enter Sense = LO
 3. Enter Value = 1244
- f. Set the calibrator output for +1.246V dc.
- g. Press MONITOR in the SCAN CONTROL group. The display should indicate a voltage of approximately +1.246V on channel 5.
- h. Increase the calibrator output until the display reads 1.248 VOLTS. At that time the LIMIT EXCEEDED indicator should start blinking.
- i. Reduce the calibrator output for a display of 1.246 VOLTS and press the limit RESET switch. The LIMIT EXCEEDED indicator should be off

NOTE

If LIMIT B (16-30) is not installed, go to step l. of this procedure.

- j. Reduce the calibrator output for a display of 1.244 VOLTS. At that time the LIMIT EXCEEDED indicator should start blinking.
- k. Increase the calibrator output for a display of 1.246 VOLTS and press the limit RESET switch. The LIMIT EXCEEDED indicator should be off.
- l. Press the RESET switch in the SCAN CONTROL group.

4-45. A/D Converter Accuracy Test

4-46. Use the following procedure to check the operation of the a/d converter (Option —09 or —10).

NOTE

This procedure assumes that the Limits Test, if applicable, has been completed and that the conditions existing at the end of that test are still present.

- a. Set the calibrator output to 0V dc.
- b. Press the MONITOR switch in the SCAN CONTROL switch group.

NOTE

If the High Performance A/D Converter (Option —10) is installed in the data logger, set its FAST/SLOW switch to SLOW.

- c. Refer to Table 4-2 and sequentially enter each of the input voltage and data logger range

combinations for channel 5 (monitor channel). As each entry is completed, check the data logger display against the indicated display readings.

- d. Disconnect the calibrator, and remove the test cable and the scanner from the 2240B
- e. Install the inner guard cover and the top dust cover.
- f. Set 2240B POWER switch to OFF and disconnect the line power.

Table 4-2. A/D Converter Accuracy Test Specifications

Input Voltage	Range (Function)	Display Reading (90 day specification, 20°C - 30°C ambient)	
		General Purpose A/D and Scanner	High Performance A/D and Low Level Scanner (Slow Speed)
0.0V	40 mV	—	-0.005 to 0.005
0.0V	400 mV	-0.03 to 0.03	-0.02 to 0.02
0.0V	4V	-0.0002 to 0.0002	-0.0002 to 0.0002
0.0V	40V	—	-0.002 to 0.002
39.9 mV	40 mV	—	39.891 to 39.906
399 mV	400 mV	398.89 to 399.11	398.94 to 399.06
3.99V	4V	3.9890 to 3.9910	3.984 to 3.996
39.9V	40V	—	39.84 to 39.96

4-47. CALIBRATION

4-48. The 2240B should be calibrated once every year or 90 days (as required to maintain desired accuracy) or whenever repairs have been made in the Power Supply or the A/D Converter (Option —09 or —10). Calibration should be accomplished at an ambient room temperature of +22 to +25°C and a relative humidity of less than 70%. Table 4-1 lists the required equipment.

4-49. Initial Procedure

- a. Remove the top dust cover from the 2240B.
- b. Press the RESET switch in the SCAN CONTROL group.
- c. Connect the 2240B to line power and set the Power switch to ON.
- d. Allow the 2240B to stabilize for a period of not less than 1 hour.

4-50. Power Supply

4-51. Use the following procedure to calibrate the Power Supply PCB:

- a. Connect the DVM to TP1 (common) and TP2 (-10.2V dc) on the Power Supply PCB. See Figure 4-3.
- b. Adjust pot R17 to obtain a reading of -10.20 $\pm$ 0.05V dc.
- c. Move the DVM input from TP2 to TP3. The DVM should read +5.1 $\pm$ 0.2V dc.
- d. Move the DVM input from TP3 to TP4. The DVM should read +16 $\pm$ 1.0V dc.

4-52. A/D Converter (Option —09 or —10)

4-53. The 2240B may contain either-of-two A/D Converters; a general purpose version (Option —09) or a high performance version (Option —10). Refer to the appropriate subsection of Section 6 for calibration instructions.

4-54. Temperature and Scaling Option (Option —11)

4-55. The Temperature and Scaling option does not require calibration. However, its accuracy is dependent upon the calibration of the A/D Converter and the Isothermal Block Connectors.

4-56. Isothermal Block Connectors (Option —08)

4-57. The basic 2240B is capable of housing up to six Isothermal Block Connectors (Option —08) for use in conjunction with the Temperature and Scaling option (Option —11). Each Isothermal Block Connector has been calibrated at the factory and does not require periodic calibration. However, if a connector has been repaired or if the seal on the factory adjustment has been broken, calibration is required. Refer to subsection —08 in Section 6, Option and Accessory Information, for the calibration procedure.

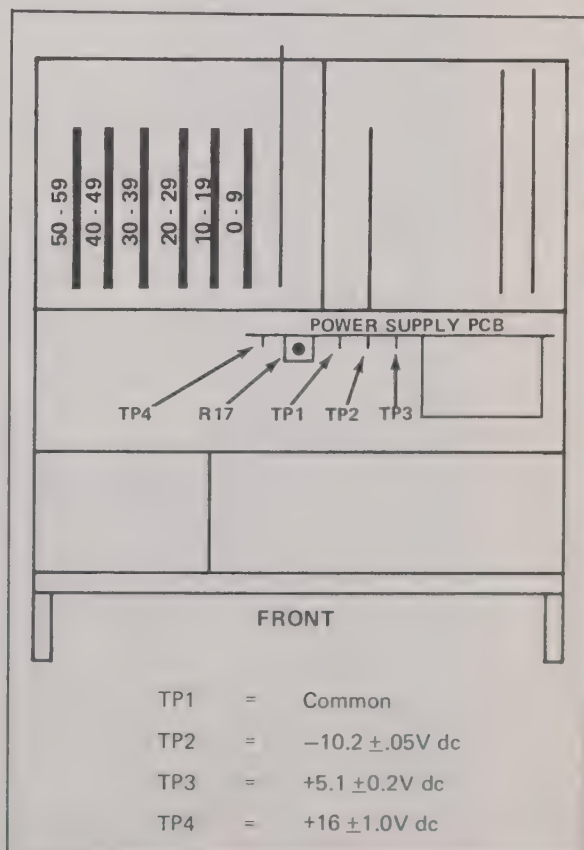


Figure 4-3. Power Supply Test Point and Adjustment Locations

4-58. TROUBLESHOOTING

CAUTION

Static discharge can damage MOS components contained in the 2240B. To prevent this possibly use the following precautions when troubleshooting and/or repairing the unit.

- Never remove, install or otherwise connect or disconnect pcb's and/or components without first turning the 2240B Power switch to OFF.
- Perform all repairs at a static free work station.
- Do not handle IC's or pcb's by their connectors.
- Use static ground straps to discharge repair personnel.
- Use conductive foam to store replacement or removed IC's.
- Remove all plastic, vinyl and styrafoam products from the work area.

- Use a grounded soldering iron.

4-59. A troubleshooting guide for the 2240B is given in Table 4-3. The guide is in the form of a tabular flow chart and is recommended for use in isolating a 2240B mainframe malfunction to the pcb (board) level. Details necessary to troubleshoot faulty pcb's to the component level can be derived from the schematic diagrams given in Section 8 and the theory of operation in Section 3.

4-60. When troubleshooting the 2240B in accordance with Table 4-3 the following notes apply.

- Do not start in the middle of the procedure. Any given step assumes that the previous steps have been completed.
- All measurements using external test equipment are reference to logic common (TP1 on Power Supply PCB) unless otherwise specified.
- All connectors referenced for measurement are accessible from the bottom of the 2240B when the bottom dust cover is removed. See Figure 4-4 for connector and pin identification.

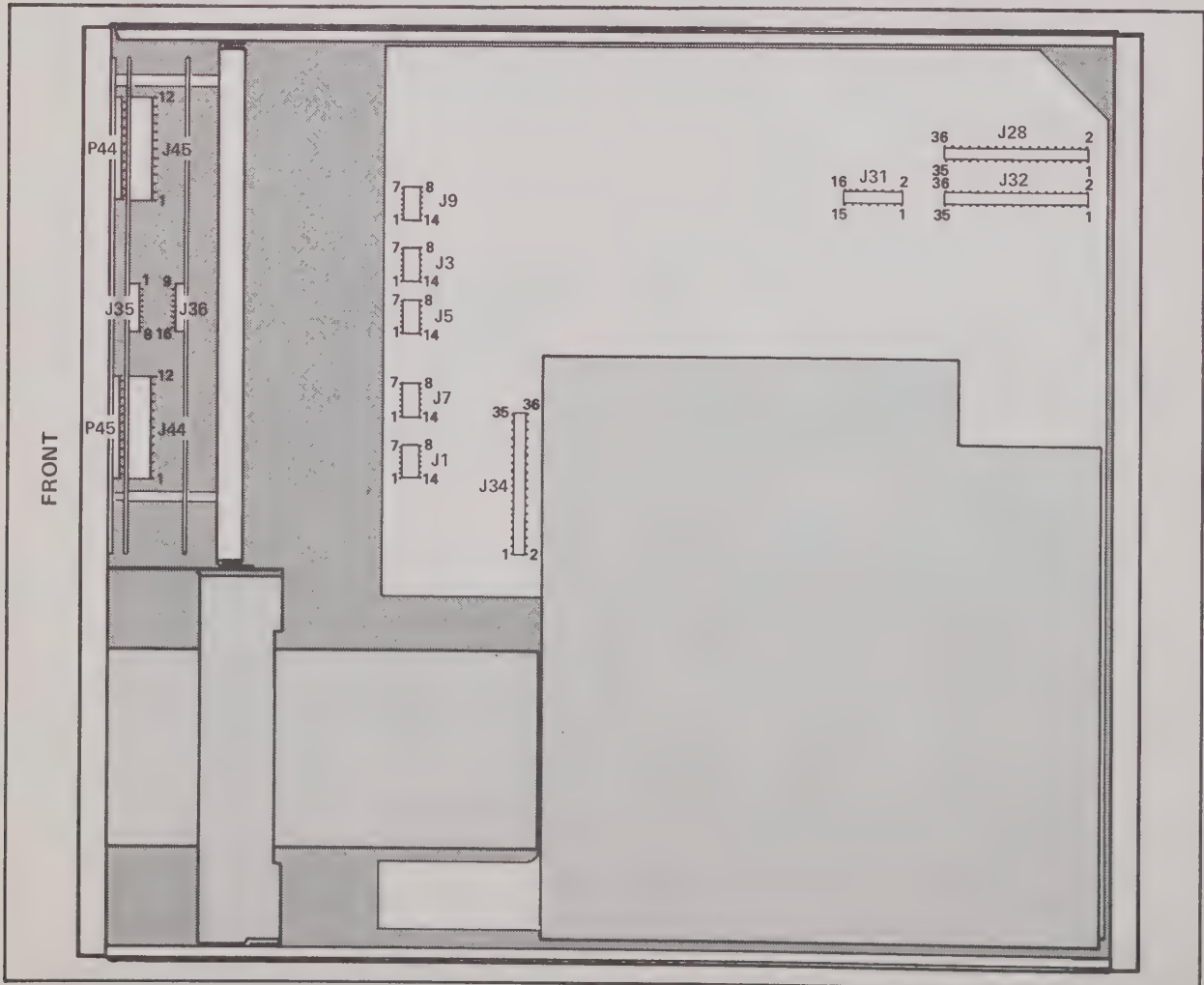


Table 4-3. Troubleshooting

STEP NO.	INSTRUCTION	YES	NO	GO TO
1.	Turn 2240B Power switch to OFF and disconnect power cord at rear panel.			2
2.	Remove the top and bottom dust covers, and the two inner guard covers from the 2240B.			3
3.	Remove all scanner pcb's and input connectors from the scanner section.			4
4.	Remove all option pcbs that may be installed in the digital I/O section.			5
5.	Remove the A/D Converter PCB and the Guard Crossing PCB.			6
6.	Disconnect the printer cable at the Printer Drive PCB.			7
7.	Connect the 2240B to line power and set the Power switch to POWER ON.			8
8.	Refer to procedure given in paragraph 4-50 and verify the presence and accuracy of all power supply voltages. If necessary: a. Isolate and relieve any shorted output conditions. b. Repair and/or calibrate the power supply.			9
	INITIAL TURN ON			
9.	Set the 2240B Power switch to POWER OFF, wait 10 seconds, and then to POWER ON. Observe the front panel display. Does it read 2240 3?	10	19	
10.	Does the display change to 00 0003 in approximately 3-seconds and begin to count-up?	11	14	
11.	Is the POWER FAILURE LED on or blinking?	12	15	
12.	Check the operation of the front panel keyboard. Do all keys appear to be operational?	13	18	
13.	Initial turn-on appears normal.			40
14.	If display continues to read 2240 3 check for continuously low outputs on the following lines: Control Bus A — P32-7 (CA2) TIM — P32-31 (1 Hz square wave)			9
15.	Is the IMPROPER ENTRY LED blinking?	16	17	
16.	Check Control Bus B a P32-12 (CB3) for a continuously low condition.			9
17.	Check for presence of In strobe at P32-15.			9
18.	Check Control Bus B at P32-9 (CB0) and P32-10 for a continuously low condition.			9
19.	Does the display read a series of 1111's (may go blank after initial turn-on)?	20	27	
20.	Is the IMPROPER ENTRY LED blinking or on?	21	26	
21.	Is the POWER FAILURE LED blinking?	22	25	
22.	Does front panel keyboard appear to be operational?	23	24	
23.	If all PROGRAMMING LIMITS LED's are lit, check P32-16 for the presence of the Out strobe. Also check for continuously low A0 through A7 outputs of J9 (pins 1 through 4 and 11 through 14).			9
24.	Check Mode Switch PCB (U11 and U12).			9

Table 4-3. Troubleshooting (Continued)

STEP NO.	INSTRUCTION	YES	NO	GO TO
25.	If limit program prompting LED's are on, 2ø clock on Controller is defective. If limit program prompting LED's are off, check for continuously low IRQ line at J32-13.			9
26.	Check Control Bus A for continuously low outputs. P32-5, -6, -7, -8 (CA0, CA1, CA2, and CA3, respectively).			9
27.	Is the display blank upon turn on and remain blank?	28	33	
28.	Does the POWER FAILURE LED blink and the IMPROPER ENTRY LED off?	29	30	
29.	Check U19-3 (BI) on the Mode Switch PCB. If continuously high, check the operation of U4 and U1 and the associated circuitry on the Mode Switch PCB.			9
30.	Is the IMPROPER ENTRY LED blinking and the POWER FAIL LED off?	31	32	
31.	If the PROGRAMMING LIMITS prompting LED's are lit the Power-On-Reset (POR) signal from the Power Supply PCB (J32-18) is continuously low. If all annunciator LED's (mV, V, Temperature, Date and Time) are lit, check for a continuously low condition at J42-13(A) on the Mode Switch Assembly.			9
32.	Check for the presence of a continuously low SYNC pulse at J32-17.			9
33.	Does a series of three like characters appear in the CHANNEL display prior to the 3 second time out?	34	37	
34.	Does data display read 888880?	35	36	
35.	U9 on the Mode Switch Assembly and/or its associated circuitry is not operating.			9
36.	Check the Data Bus at P32-1, -2, -3 and -4 (DB0, DB1, DB2, and DB3, respectively) for the presence of a continuously low output.			9
37.	Does a series of three like-characters other than 000 appear in the CHANNEL display after the three second time out?	38	39	
38.	Check the operation of U5 on the Mode switch.			9
39.	If only one or two of the six display digits are lit check for a continuously low condition at J42-10, -11 and -12 (D, C, B) on the Mode Switch PCB Assembly.			9
	DISPLAY AND DATA ENTRY			
40.	Refer to paragraph 4-29 and complete the Display and Data Entry Test.			41
41.	Does the display and keyboard respond properly?	61	42	
42.	Does the keyboard appear to respond?	43	48	
43.	Are all digits in a series of entered numbers displayed the same, e.g., 111111, 222222, etc?	44	46	
44.	Are digits displayed as entered on both DATA and CHANNEL displays?	45	47	
45.	Defective Mode Switch Assembly, Repair as required.			40

Table 4-3. Troubleshooting (Continued)

STEP NO.	INSTRUCTION	YES	NO	GO TO
46.	Some digits are blank or some character segments are not lit. Defective Display Assembly. Check U3 and U6 outputs. Check transistor drivers Q1 through Q11. Check LED elements by interchanging decades.			40
47.	Channel Display PCB is defective. Check U1 and U4. Repair as required.			40
48.	Make sure Power switch is set to POWER ON. Use scope to check for the presence of a 3 kHz clock at J45-4. Is clock present?	50	49	
49.	Keyboard Logic PCB is defective. Check for presence of +5V dc and the operation of oscillator formed by U11. Repair as required.			40
50.	Use scope to check for the presence of 1-2-4-8 outputs from binary counter. J45-10, -1, -8, -7 (1-2-4-8 respectively). Are counter outputs correct?	52	51	
51.	Defective Keyboard Logic PCB. Check U12 and U16. Repair as required.			40
52.	Use scope to monitor 3 kHz clock at P45-4 and individually press all front panel momentary type switches (not PAPER ADVANCE). The clock should stop when any one of the switches is depressed. Ignore order in which switches are pressed.			53
53.	Does clock stop for each switch that is pressed?	54	58	
54.	Keyboard Switch Assembly is functional.			55
55.	Was a tone generated with any of the switch depressions?	57	56	
56.	Check for presence of In and Out strobe pulses at J35-3 and J35-2, respectively. If not present Controller is defective. If present, Control Bus B decoder on Keyboard Logic PCB Assembly is defective. Also check tone generator circuit on Keyboard Logic PCB. Repair as required.			40
57.	Check multiplexer operation of U6 and U7 on Keyboard Logic PCB Assembly. If okay, Controller is defective. Repair as required.			40
58.	Does clock stop for all switch depression except one or two?	59	60	
59.	Switch is defective on Keyboard Logic PCB Assembly.			40
60.	If clock does not stop for any switch depression, U1 on Keyboard Switch Assembly is defective. Repair as required.			52
61.	SCAN FORMAT Enter the following scan format data and observe the display as the ENTER/STEP switch is pressed for each entry. FIXED DATA — 123456 INTERVAL — 10 seconds FIRST CHANNEL — 0 MONITOR CHANNEL — 5 LAST CHANNEL — 10			62
62.	Does display data change or shift when the ENTER/STEP switch is pressed. (The addition of leading zeros is not considered a change in data?)	63	64	
63.	Check the following IC's on the Keyboard Memory PCB and repair as required: U1 — First, Last and Monitor Channels U2 — Fixed and Interval Data			61

Table 4-3. Troubleshooting (Continued)

STEP NO.	INSTRUCTION	YES	NO	GO TO
64.	Set Power switch to POWER OFF, wait 1 minute, then return switch to POWER ON. Recall scan format data.			65
65.	Is recalled data the same as previously entered?	67	66	
66.	If recalled data comprises a series of 69's, the battery on the Keyboard Memory PCB is defective or switched off. Check switch position (located next to battery) and battery. Repair as required.			61
67.	Program channels 0 through 10 with the following function and limit address data. Function — 4V *LIMIT ADDRESS A — Skip *LIMIT ADDRESS B — Skip <i>*Applicable only if the 2240B is equipped with limit option (—22).</i>			68
68.	Did program prompting LED's react normally?	70	69	
69.	Defective Keyboard Switch and/or Logic PCB.			67
70.	Recall and verify the program data for channels 0 through 10.			71
71.	Is recalled data correct?	73	72	
72.	Memory IC's on Range and Function Memory PCB are defective. Try interchanging IC's and reprogramming to verify defect. Function IC's U10 Channels 0-127 U18 Channels 128-999 Limit A Address IC's U12 Channels 0-127 U11 Channels 128-999 Limit B Address IC's U17 Channels 0-127 U19 Channels 128-999			67
73.	Sequentially press each of the SCAN CONTROL switches and observe the CHANNEL display to verify proper scanning operation in each mode. Ignore the DATA display characters. However, check the annunciator LED's to ensure that VOLTS is lit during the actual scan sequence (TEMPERATURE and MILLIVOLTS should not blink). SINGLE — Single scan should occur. Channel data will stop and remain at 10. INTERVAL — Repeated scan sequences with a 10 second time interval between the start of each scan. Display will read the date and time between scans. MONITOR — Continuously displays channel 5. CONTINUOUS — Continuously scans channel 0-10 with a minimum delay (<1 second) between the end of one scan sequence and the start of the next. REMOTE — Displays date and time, no scan sequence.		74	
74.	Do all scan sequences react normally?	76	75	
75.	Check the operation of each Mode switch and its associated driver on the Mode Switch PCB Assembly.			73
76.	Press the CONTINUOUS scan mode switch			77

Table 4-3. Troubleshooting (Continued)

STEP NO.	INSTRUCTION	YES	NO	GO TO
77.	Momentarily press the PAPER ADVANCE switch in the OUTPUT CONTROL switch group.			78
78.	Does the scan sequence stop and remain at channel 10?	80	79	
79.	Defective Printer Drive PCB or Mode Switch PCB. Repair as required.			80
80.	Turn Power switch to POWER OFF then to POWER ON. Scan sequence will resume.			81
81.	Turn Power switch to POWER OFF.			82
82.	Connect Printer cable to Printer Drive PCB and set Power switch to ON.			83
83.	Does printer sound like it's running?	85	84	
84.	Check $\pm 16V$ dc on Power Supply PCB. If voltage is okay, printer head is defective. Repair as required.			81
85.	Press PAPER ADVANCE switch.			86
86.	Does printer advance paper?	88	87	
87.	If scan sequence stops, printer head is defective. Interrupting power will resume scan sequence. Repair or replace printer head.			81
88.	Sequentially press the following switches: RESET (SCAN CONTROL) ALL DATA (PRINTER ENABLE) SINGLE (SCAN CONTROL)			89
	The printer should print:			
	10 :--:- V			
	9 :--:- V			
	8 :--:- V			
	7 :--:- V			
	6 :--:- V			
	5 :--:- V			
	4 :--:- V			
	3 :--:- V			
	2 :--:- V			
	1 :--:- V			
	0 :--:- V			
	1 2 3 4 5 6			
	000:00:04:34			
89.	Release the ALL DATA switch and press ALARM DATA (PRINTER ENABLE).			90
90.	Does the printer print?	91	92	
91.	Note channels printed and verify that Limit A and B addresses for those channels are skipped.			67
92.	Release the ALARM DATA switch, press INTERVAL DATA and then press CONTINUOUS (SCAN CONTROL). The printer should print data for channels 0 through 10 once during each interval period. In this case 10 seconds. The scan continues normally between intervals.			93
93.	Release the INTERVAL DATA switch. The scanning sequence should continue but data will not be printed.			94

Table 4-3. Troubleshooting (Continued)

STEP NO.	INSTRUCTION	YES	NO	GO TO
94.	Does the printer respond normally to the PRINTER ENABLE switch settings?	96	95	
95.	Defective Mode Switch, Printer Drive PCB or Printer head. Repair as required.			88
	DISPLAY CONTROL TEST			
96.	Press FIRST CHANNEL in the SCAN FORMAT group, and then CHANNEL ENABLE in the PROGRAMMING group. The display should read: 000 4.000 volts			97
97.	Press ALL CHANNELS in the DISPLAY CONTROL group. The continuous scan of channels (0 through 10) should be displayed.			98
98.	Press SINGLE CHANNEL in the DISPLAY CONTROL group. The CHANNEL display should read 004.			99
99.	Press DATE AND TIME in the DISPLAY CONTROL group. The time-of-day and date code should be displayed.			100
100.	Does the display respond normally to the DISPLAY CONTROL settings?	102	101	
101.	Defective Keyboard Switch PCB or Keyboard Memory PCB. Repair as required.			96
	PROGRAM LIST			
102.	Press RESET in the SCAN CONTROL group and ALL DATA in the PRINTER ENABLE group.			103
103.	Press PROGRAM LIST. The printer should record: Date and time, interval time, monitor channel, all available limits by address and their assigned values (may read any value at this point), all programmed channels (0-10) by address and their assigned function data. All channels should show the 4V function (4.0000V).			104
104.	Is program data listed properly?	106	105	
105.	Missing column data indicates defective printer head. If no list is printed PROGRAM LIST switch or Printer Drive PCB may be defective. Missing digits in LIMIT data only indicates that the limits need programming or the Keyboard Memory PCB is defective. If this is the case go to the next step. If printed data does not agree with displayed data, check the Printer Drive PCB.			102
	PROGRAMMING LIMITS			
106.	If the limit(s) option (—22) is installed, program each available limit (as indicated on the previously printed Program List) to <00000. Observe the display as each limit value is entered with the ENTER/STEP switch.			107
107.	Does entered data for one or more channels change when the ENTER/STEP switch is pressed?	108	109	

Table 4-3. Troubleshooting (Concluded)

STEP NO.	INSTRUCTION	YES	NO	GO TO																																																				
108.	One of the following IC's on the Keyboard Memory PCB is defective. Repair is required. <table><tr><th>LIMIT ADDRESS</th><th>IC</th></tr><tr><td>1 through 3</td><td>U3</td></tr><tr><td>4 through 7</td><td>U4</td></tr><tr><td>8 through 11</td><td>U5</td></tr><tr><td>12 through 15</td><td>U12</td></tr><tr><td>16 through 18</td><td>U11</td></tr><tr><td>19 through 22</td><td>U8</td></tr><tr><td>23 through 26</td><td>U7</td></tr><tr><td>27 through 30</td><td>U6</td></tr></table>	LIMIT ADDRESS	IC	1 through 3	U3	4 through 7	U4	8 through 11	U5	12 through 15	U12	16 through 18	U11	19 through 22	U8	23 through 26	U7	27 through 30	U6			106																																		
LIMIT ADDRESS	IC																																																							
1 through 3	U3																																																							
4 through 7	U4																																																							
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16 through 18	U11																																																							
19 through 22	U8																																																							
23 through 26	U7																																																							
27 through 30	U6																																																							
109.	Program channels 0 through 10 with the following function data, and review after entry. <table><tr><th colspan="2">PROGRAM DATA</th><th colspan="2">REVIEW DATA</th></tr><tr><th>CHANNEL</th><th>FUNCTION</th><th>CHANNEL DISPLAY</th><th>DATA DISPLAY</th></tr><tr><td>0</td><td>T1</td><td>000</td><td>1</td></tr><tr><td>1</td><td>T2</td><td>001</td><td>2</td></tr><tr><td>2</td><td>T3</td><td>002</td><td>3</td></tr><tr><td>3</td><td>T4</td><td>003</td><td>4</td></tr><tr><td>4</td><td>40 mV</td><td>004</td><td>40.000 Millivolts</td></tr><tr><td>5</td><td>400 mV</td><td>005</td><td>400.00 Millivolts</td></tr><tr><td>6</td><td>HI LIMIT</td><td>006</td><td>40000</td></tr><tr><td>7</td><td>4V</td><td>007</td><td>4.0000 Volts</td></tr><tr><td>8</td><td>40V</td><td>008</td><td>40.000 Volts</td></tr><tr><td>9</td><td>SKIP</td><td>009</td><td>s s s</td></tr><tr><td>10</td><td>SKIP</td><td>010</td><td>s s s</td></tr></table>	PROGRAM DATA		REVIEW DATA		CHANNEL	FUNCTION	CHANNEL DISPLAY	DATA DISPLAY	0	T1	000	1	1	T2	001	2	2	T3	002	3	3	T4	003	4	4	40 mV	004	40.000 Millivolts	5	400 mV	005	400.00 Millivolts	6	HI LIMIT	006	40000	7	4V	007	4.0000 Volts	8	40V	008	40.000 Volts	9	SKIP	009	s s s	10	SKIP	010	s s s			
PROGRAM DATA		REVIEW DATA																																																						
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4	40 mV	004	40.000 Millivolts																																																					
5	400 mV	005	400.00 Millivolts																																																					
6	HI LIMIT	006	40000																																																					
7	4V	007	4.0000 Volts																																																					
8	40V	008	40.000 Volts																																																					
9	SKIP	009	s s s																																																					
10	SKIP	010	s s s																																																					
110.	Program data correctly entered and verified?	112	111																																																					
111.	Defective range and function memory. Repair as required.			109																																																				
112.	Turn Power switch to POWER OFF, install Guard Crossing PCB PCB and set the Power switch to POWER ON. Review channel data entered earlier in this procedure. The following results should be obtained for the units that display 2240 3 on initial turn on. <table><tr><th>PROGRAM CHANNEL</th><th>CHANNEL DISPLAY</th><th>DATA DISPLAY</th></tr><tr><td>0</td><td>000</td><td>1</td></tr><tr><td>1</td><td>001</td><td>2</td></tr><tr><td>2</td><td>002</td><td>3</td></tr><tr><td>3</td><td>003</td><td>4</td></tr><tr><td>4</td><td>*004</td><td>40.000 Millivolts (flashing)</td></tr><tr><td>5</td><td>005</td><td>400.00 Millivolts</td></tr><tr><td>6</td><td>*006</td><td>40000 (flashing)</td></tr><tr><td>7</td><td>007</td><td>4.0000 Volts</td></tr><tr><td>8</td><td>*008</td><td>40.000V (flashing)</td></tr><tr><td>9</td><td>009</td><td>s s s</td></tr><tr><td>10</td><td>010</td><td>s s s</td></tr></table>	PROGRAM CHANNEL	CHANNEL DISPLAY	DATA DISPLAY	0	000	1	1	001	2	2	002	3	3	003	4	4	*004	40.000 Millivolts (flashing)	5	005	400.00 Millivolts	6	*006	40000 (flashing)	7	007	4.0000 Volts	8	*008	40.000V (flashing)	9	009	s s s	10	010	s s s			113																
PROGRAM CHANNEL	CHANNEL DISPLAY	DATA DISPLAY																																																						
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9	009	s s s																																																						
10	010	s s s																																																						
113.	Is reviewed channel data correct?	115	114																																																					
114.	Guard crossing defective. Repair as required.			109																																																				
115.	2240B Mainframe is operational.																																																							

Section 5

List of Replaceable Parts

TABLE OF CONTENTS

REFERENCE DESIGNATOR	NAME	PART NO.	PAGE
	2240B Final Assembly		5-3
A1	Mother Board PCB Assembly	406306	5-8
A2	Power Supply PCB Assembly	409433/426676	5-9
A3	Controller PCB Assembly	451013	5-12
A4	Guard Crossing PCB Assembly	409458	5-14
A5	Printer Drive PCB Assembly	409482	5-16
A6	Display PCB Assembly	409656	5-18
A7	Mode Switch PCB Assembly	409664	5-20
A8	Keyboard Switch PCB Assembly	409672	5-21
A9	Keyboard Logic PCB Assembly	409680	5-22
A10	Keyboard Memory PCB Assembly	409698	5-24
A11	Range and Function Memory PCB Assembly	412445	5-25

5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown of the instrument. Components are listed alphabetically by assembly. Electrical components are listed by reference designation and mechanical components are listed by item number. Each listed part is shown in an accompanying illustration.

5-3. Parts lists include the following information:

- a. Reference Designation or Item Number.
- b. Description of each part.
- c. Fluke Stock Number.
- d. Federal Supply Code for Manufacturers.
- e. Manufacturer's part Number or Type.
- f. Total Quantity per assembly or component.
- g. Recommended Quantity: This entry indicates the recommended number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that at least one of each assembly in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc, that are not always part of the instrument, or are deviations from the basic instrument mode, the REC QTY column lists the recommended quantity of the item in that particular assembly.

- h. Use Code is provided to identify certain parts that have been added, deleted or modified during production of the instrument. Each part for which a use code has been assigned may be identified with a particular instrument by consulting the Rev. letter printed (in ink) on the assembly.

5-4. HOW TO OBTAIN PARTS

5-5. Components may be ordered directly from the manufacturer by using the manufacturer's part number, or from the John Fluke Mfg. Co., Inc. factory or authorized representative by using the FLUKE STOCK NUMBER. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

5-6. To ensure prompt and efficient handling of your order, include the following information.

- a. Quantity
- b. FLUKE Stock Number
- c. Description
- d. Reference Designation or Item Number
- e. Printed Circuit Board Part Number and rev. letter (use code) as printed in ink on the PCB.
- f. Instrument model and Serial number



CAUTION

Indicated devices are subject to damage by static discharge.

2240B FINAL ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	FINAL ASSEMBLY MODEL 2240B Figure 5-1.						
A1	Mother Board PCB Assembly, tested (2200A-4001T) Figure: 8-2	406306	89536	406306	1		
A2	Power Supply PCB Assembly (Standard) (2200A-4002T) Figure: 8-3	409433	89536	409433	1		
A2	Power Supply PCB Assembly (100V Model) (2200A-4018T) Figure: 8-3	426676	89536	426676	1		
A3	Controller PCB Assembly, tested (2200A-4036T) Figure: 8-4	451013	89536	451013	1		
A4	Guard Crossing PCB Assembly (Standard) tested (2200A-4004T) Figure: 8-12	409458	89536	409458	1		
A5	Printer Drive PCB Assembly, tested (2200A-4007T) Figure: 8-5	409482	89536	409482	1		
A6	Display PCB Assembly, tested (2240A-4008T) Figure 8-6	409656	89536	409656	1		
A7	Mode Switch PCB Assembly, tested (2240A-4009T) Figure 8-7	409664	89536	409664	1		
A8	Keyboard Switch PCB Assembly (2240A-4011T) Figure: 8-8	409672	89536	409672	1		
A9	Keyboard Logic PCB Assembly (2240A-4012T) Figure: 8-9	409680	89536	409680	1		
A10	Keyboard Memory PCB Assembly (2240A-4013T) Figure: 8-10	409698	89536	409698	1		
A11	Range and Function Memory PCB Assembly (2240A-4032T) Figure: 8-11	412445	89536	412445	1		
F1	Fuse, slo-acting, 3/4 A	109256	89536	109256	1		
	Fuse, slo-acting, 3/8 A (use with 230V/50 Hz)	109264	89536	109264	1		
S1	Switch, power (on keyboard bracket)	417204	89536	417204	1		
U3	IC, ROM, control (located on Controller PCB) 	454470	89536	454470	1		
U4	IC, ROM, control (located on Controller PCB) 	454488	89536	454488	1		
U6	IC, ROM, keyboard (located on Controller PCB) 	454446	89536	454446	1		
XF1	Fuse Holder	424416	89536	424416	1		

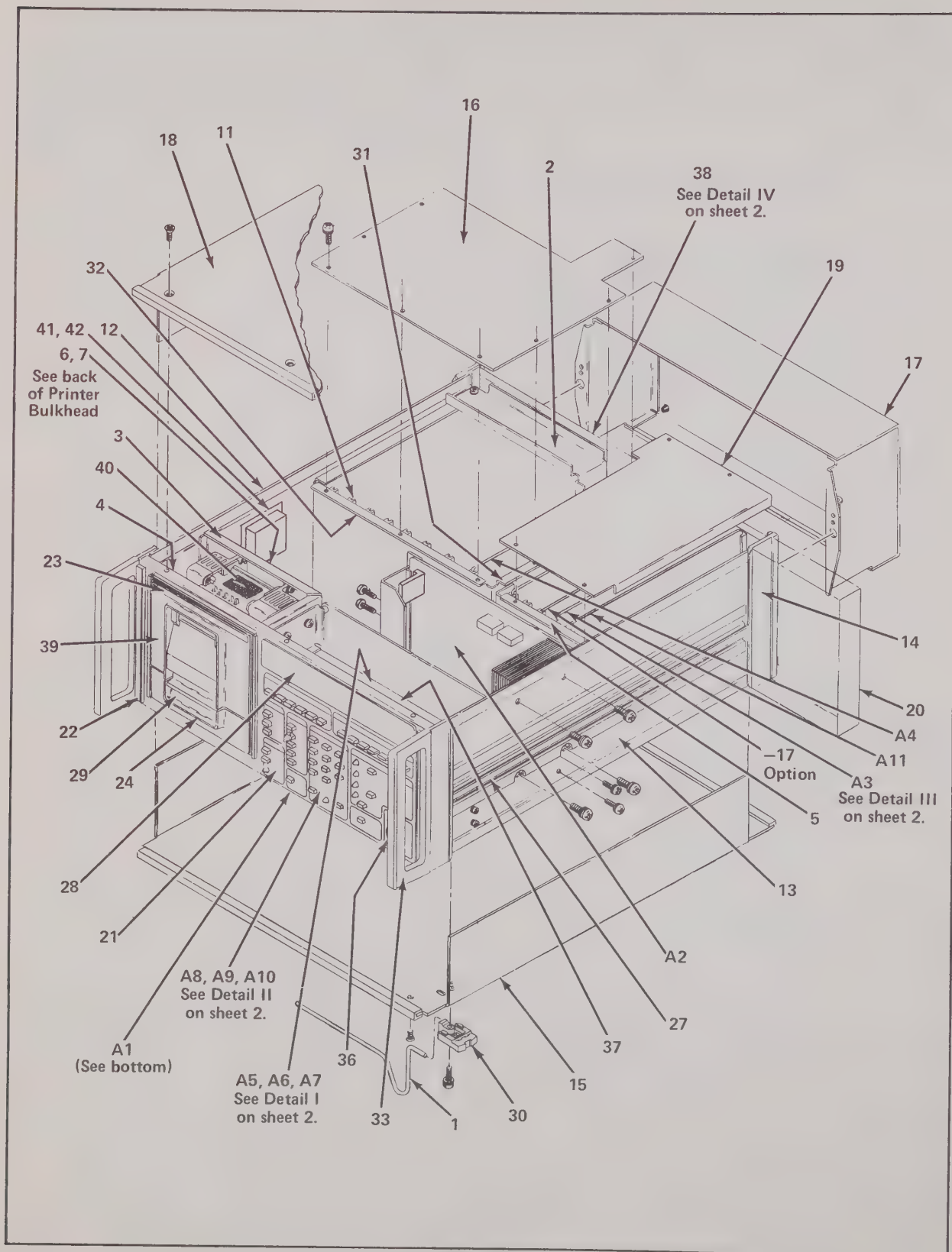


Figure 5-1. 2240B Final Assembly (Sheet 1 of 2)

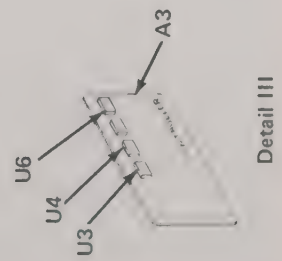
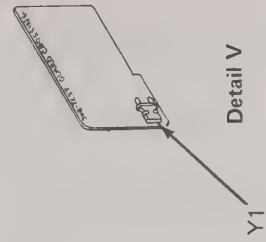
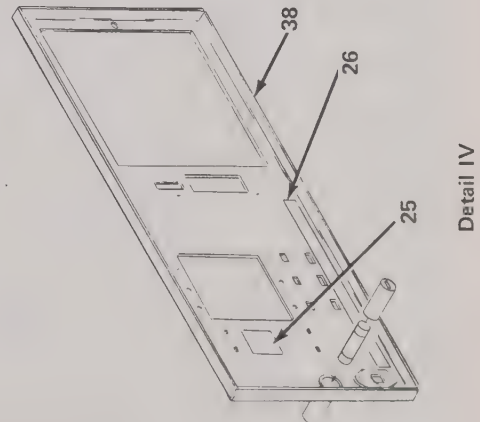
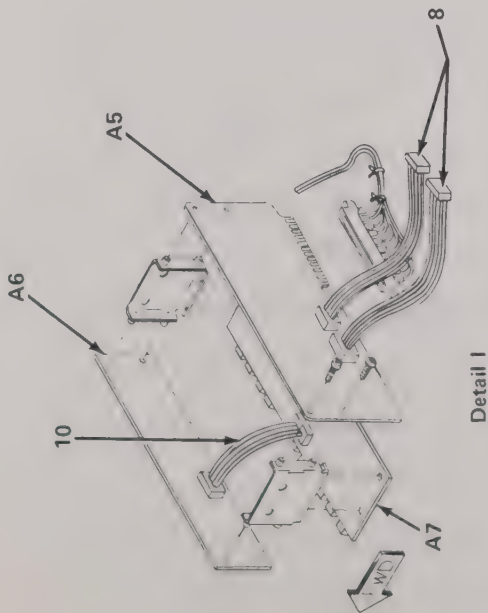
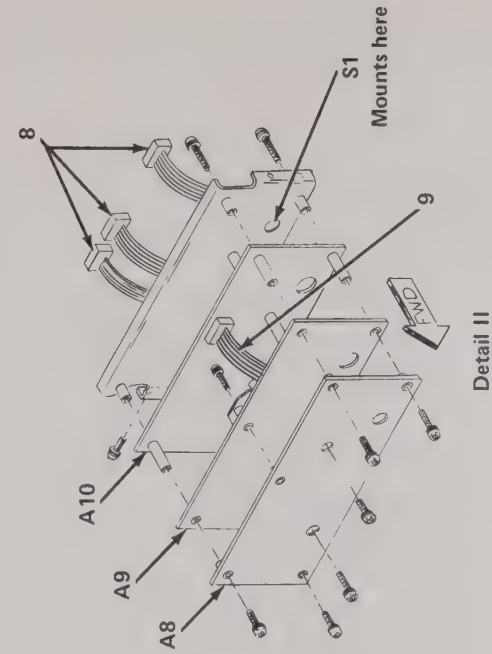


Figure 5-1. 2240B Final Assembly (Sheet 2 of 2)

2240B FINAL ASSEMBLY (cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Y1	Crystal, quartz* 2.4 MHz (use with 60 Hz line)	408153	89536	408153	1		
	2.0 MHz (use with 50 Hz line)	408161	89536	408161			
1	Bail, full width	231407	89536	231407	1		
2	Bracket, isothermal	411728	89536	411728	1		
3	Bracket, printer	412254	89536	412254	1		
4	Bracket, trim support	411694	89536	411694	1		
5	Bulkhead, unguarded	411678	89536	411678	1		
6	Bushing, nylon (for printer mechanism cable)	104620	28520	SB500-6	1		
7	Bushing, steel	375162	73734	32-201	4		
8	Cable assy	413344	32038	5132-010	5		
9	Cable assy	380576	32038	5122-003.5	1		
10	Cable assy	380568	32038	5112-003.25	1		
11	Card guide	256461	23880	1450F	17		
12	Chassis, left side	412239	89536	412239	1		
13	Chassis, right side	412247	89536	412247	1		
14	Corner, machined	423814	89536	423814	2		
15	Cover, bottom	412288	89536	412288	1		
16	Cover, guard chamber	411645	89536	411645	1		
17	Cover, rear	409623	89536	409623	1		
18	Cover, top	412270	89536	412270	1		
19	Cover, unguarded	411686	89536	411686	1		
20	Decal, corner	296277	89536	296277	4		
21	Decal, front panel	454397	89536	454397	1		
22	Decal, handle trim	295501	89536	295501	2		
23	Decal, nameplate	454314	89536	454314	1		
24	Decal, paper loading (inside paper tape drawer)	424119	89536	424119	1		
25	Decal, rear panel	454447	89536	454447	1		
	*Located on guard crossing PCB assembly.						

2240B FINAL ASSEMBLY (cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
26	Decal, rear panel, caution	428201	89536	428201	1		
27	Decal, side trim	295402	89536	295402	2		
28	Display lens	414334	89536	414434	1		
29	Drawer	412346	89536	412346	1		
29	Drawer, front	390823	89536	390823	1		
30	Foot, bail stand	292870	89536	292870	4		
31	Guard, bracket	411736	89536	411736	1		
32	Guard, chamber	411611	89536	411611	1		
33	Handle	423053	89536	423053	2		
36	Lock, key operated	417543	89536	417543	1		
37	Panel, front	411744	89536	411744	1		
38	Panel, rear	412221	89536	412221	1		
39	Printer access door	357681	89536	357681	1		
40	Printer head	355446	54124	102	1		
41	Base, battery	461895	89536	462895	1		
42	Battery Assembly	462887	89536	462887	1		
	Bushing, nylon (located on bottom of printer paper drawer)	102988	28520	SB250-2	4		
	Card guide (printer-paper drawer slides)	229047	23880	1800F	2		
	Card guide (short guides located on Mother Board)	298836	89536	298836	21		
	Clamp, battery cable	100826	89536	100826	3		
	Clamp, printer cable	165951	31827	3-4-1	1		
	Grommet, printer, rubber	135269	83330	135269	4		
	Guard, plane (located on bottom of Mother Board)	411637	89536	411637	1		
	Line cord	343723	89536	343723	1		
	Paper tape (located in printer paper drawer)	362962	89536	362962	1		
	Paper Tray Assy	414904	89536	414904	1		
	Printer cutter bar (located on printer head)	423954	54124	1425120	1		
	Ribbon, typewriter (located on printer head)	364117	89536	364117	1		
	Power switch cable (connects to power supply)	374009	89536	374009	1		
	Power cable (from rear panel line cord connector)	398115	89536	398115	1		
	Power switch cable (connects to power cable)	419952	89536	419952	1		

A1 MOTHER BOARD PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A1	MOTHER BOARD PCB ASSEMBLY (2200A-4001T) Figure 8-2	409425	89536	409425	REF		
C1, C3, C4	Cap, cer, 20,000 pF $\pm$ 20%	407403	72982	811-000- Z5U0203M	3		
J1, J3, J5, J7, J9	Socket, 14-pin, DIP	387316	71785	133-59-02-059	5		
J11	Conn, 12-pin	291898	00779	583650-2	6		
J12, J24	Conn, 6-pin	291625	00779	583650-1	7		
J23, J26, J27, J28, J32, J34	Conn, 36-pin	404947	00779	1-583407-8	6		
J25, J31	Conn, 16-pin	408484	00779	583407-9	2		
	Key, connector, polarizing	424572	00779	530286-2	25		

A2 POWER SUPPLY PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A2	POWER SUPPLY PCB ASSEMBLY (STANDARD) (2200A-4002T) Figure 8-3	409433	89536	409433	REF		
A2	POWER SUPPLY PCB ASSEMBLY (100V) (2200A-4018T) Figure 8-3	426676	89536	426676	REF		
C1, C2	Cap, elect, 100 μ F -10/+50%, 40V	236919	73445	ET101X040A6	2	1	
C3	Cap, elect, 8000 μ F -10/+100%, 15V	309245	12676	61C15AS83	1	1	
C4, C6, C9, C11	Cap, Ta, 10 μ F $\pm$ 20%, 20V	330662	56289	196D106X- 0020KA1	4		
C5	Cap, elect, 15,000 μ F -10/+75%, 15V	310367	06001	86F520	1	1	
C7	Cap, Ta, 1 μ F $\pm$ 20%, 35V	161919	56289	196D105X- 0020JA1	1		
C8, C14, C16	Cap, cer, 50,000 pF $\pm$ 20%, 100V	149161	56289	55C23A1	3		
C10	Cap, elect, 8000 μ F -10/+100%, 25V	309971	12954	39C025SL83	1	1	
C12	Cap, Ta, 4.7 μ F $\pm$ 20%, 25V	161943	56289	196D475X- 0025KA1	1		
C13	Cap, cer, 2000 pF GMV, 1 kV	105569	71590	DA140-139CB	1		
C15	Cap, elect, 2100 μ F -10/+100%, 35V	370742	12954	33C35JJ212	1	1	
CR1, CR2 CR10	Diode bridge	296509	09423	FB200	3	1	
CR3, CR4, CR5, CR6	Diode, Si, high voltage	325746	04713	MR751	4	1	
CR11, CR12, CR14, CR15, CR16	Diode, Si, low power	203323	07910	1N4448	5	1	
J48	Connector, 3-pin Pin, connector	417154 342998	27264 27264	03-09-2032 02-09-2133	1 3		
Q1	Xstr, Si, NPN	418095	95303	2N6383	1	1	
Q2, Q4, Q5, Q10	Xstr, Si, NPN	218396	04713	2N3904	4	1	

A2 POWER SUPPLY PCB ASSEMBLY (cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Q3	Xstr, Si, NPN	386128	01295	T1P120	1	1	
Q6, Q7, Q11	Xstr, Si, PNP	195974	04713	2N3906	3	1	
Q8	Xstr, Si, NPN	325720	04713	MJE3055	1	1	
Q9	Xstr, FET, N-chan	261578	07910	U2366E	1	1	
R1	Res, comp, $2K \pm 5\%$, $\frac{1}{4}W$	202879	01121	CB2025	1		
R2	Res, mf, $953 \pm 1\%$, $\frac{1}{8}W$	288555	91637	MFF1-89530F	1		
R3	Res, mf, $2.37K \pm 1\%$, $\frac{1}{8}W$	293720	91637	MFF1-82371F	1		
R4, R6	Res, comp, $47K \pm 5\%$, $\frac{1}{4}W$	148163	01121	CB4735	2		
R5, R23	Res, comp, $1K \pm 5\%$, $\frac{1}{4}W$	148023	01121	CB1025	2		
R7	Res, comp, $510 \pm 5\%$, $\frac{1}{4}W$	218032	01121	CB5115	1		
R9	Res, ww, $0.62 \pm 5\%$, 2W	219352	75042	BWHR62J	1	1	
R10	Res, comp, $2.7K \pm 5\%$, $\frac{1}{4}W$	170720	01121	CB2725	1		
R11	Res, mf, $7.50K \pm 1\%$, $\frac{1}{8}W$	223529	91637	MFF1-87501F	1		
R12	Res, comp, $15K \pm 5\%$, $\frac{1}{4}W$	148114	01121	CB1535	1		
R13, R26, R27	Res, mf, $10K \pm 1\%$, $\frac{1}{8}W$	168260	91637	MFF1-81002F	3		
R14	Res, mf, $1.15K \pm 1\%$, $\frac{1}{8}W$	293597	91637	MFF1-81151F	1		
R15	Res, comp, $2.4K \pm 5\%$, $\frac{1}{4}W$	193443	01121	CB2425	1		
R16	Res, comp, $100 \pm 10\%$, $\frac{1}{4}W$	193185	01121	CB1011	1		
R17	Res, var, $50 \pm 10\%$, $\frac{1}{2}W$	291120	71450	360S103A	1	1	
R18	Res, comp, $5.1K \pm 5\%$, $\frac{1}{4}W$	193342	01121	CB5125	1		
R19, R28	Res, comp, $100K \pm 5\%$, $\frac{1}{4}W$	148189	01121	CB1045	2		
R20, R22	Res, ww, $1.2 \pm 5\%$, 2W	248658	75042	BWH1R2J	2	1	
R21	Res, comp, $330 \pm 5\%$, $\frac{1}{4}W$	147967	01121	CB3315	1		
R24	Res, mf, $5.11K \pm 1\%$, $\frac{1}{8}W$	294868	91637	MFF1-85111F	1		
R25	Res, comp, $22M \pm 10\%$, 2W	108233	01121	EB2261	1		
S1	Switch, slide, DPDT	234278	82389	XW1649	1	1	
S2	Switch, slide SPDT	386813	C.W. Inds	GS-111-SPDT	1	1	

A2 POWER SUPPLY PCB ASSEMBLY (cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
T1	Xfmr, power (Standard)	409979	89536	409979	1		
T1	Xfmr, power (100V)	427765	89536	427765	1		
U1	IC, CMOS, hex buffer 	381830	04713	MC14050CP	1	1	
U2	IC, lin, opnl ampl	310219	12040	LM304H	1	1	
U3	IC, CMOS, time base generator 	404251	04713	MC14566CP	1	1	
VR1	IC Lin, volt, reg	355107	07263	F7805UC	1	1	
VR2	Diode, zener	277236	07910	1N752A	1	1	
1	Heat sink	411710	89536	411710	1	1	
2	Heat sink	386235	13103	6032D	2		
3	Heat sink	374934	89536	374934	1		
4	Socket, IC, 16-pin	276535	91506	316AG39D	2		
	Nameplate (100V only)	433862	89536	433862	1		

A3 CONTROLLER PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A3	CONTROLLER PCB ASSEMBLY (2200A-4036) Figure 8-4.	451013	89536	451013	REF		
C1, C3 C4	Cap, cer, .01 μ F -20/+80%, 25V	335786	72982	5835-000Y5- U103Z	3		
C2	Cap, mica, 51 pF $\pm$ 5%, 500V	277210	72136	DM15E510J	1		
C5, C6	Cap, Ta, 2.2 μ F, $\pm$ 20%, 15V	364216	56289	196D222X- 0015HA1	2		
C7, C8	Cap, Ta, 10 μ F $\pm$ 20%, 15V	193623	56289	196D100X- 0015KA1	2		
C9, C10	Cap, cer, 0.025 μ F $\pm$ 20%, 100V	168435	56289	C023B101- H253M	2		
Q1	Xstr, Si, PNP	229898	04713	MPS6522	1	1	
Q4	Xstr, Si, NPN	218081	04713	MPS6520	1	1	
R1, R2	Res, comp, 820 $\pm$ 5%, $\frac{1}{4}$ W	442327	01121	CB8215	2		
R3, R15, R19, R21, R22, R24	Res, comp, 1K $\pm$ 5%, $\frac{1}{4}$ W	343426	01121	CB1025	6		
R4, R5	Res, comp, 5.6K $\pm$ 5%, $\frac{1}{4}$ W	442350	01121	CB5625	2		
R6, R7 R18, R23	Res, comp, 110 $\pm$ 5%, $\frac{1}{4}$ W	442285	01121	CB1115	4		
R8, R10, R11, R12	Res, comp, 470 $\pm$ 5%, $\frac{1}{4}$ W	343434	01121	CB4715	4		
R17, R25	Res, comp, 10K $\pm$ 5%, $\frac{1}{4}$ W	348839	01121	CB1035	2		
R20	Res, comp, 100K $\pm$ 5%, $\frac{1}{4}$ W	348920	01121	CB1045	1		
S1 thru S4	Switch Assembly, 4-spst	408559	00779	435166-2	4	1	
U1	IC, TTL, hex inverter	418004	01295	SN74S04N	1	1	
U2	IC, CMOS, clock driver 	408567	12040	MH0026CN	1	1	
U7	IC, TTL, quad 2-input NAND gate	363580	01295	SN74S00N	1	1	
U3, U4, U6	See Final Assembly						

A3 CONTROLLER PCB ASSEMBLY (cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U8	IC, TTL, counter	340463	01295	SN74163N	1	1	
U9	IC, CMOS, 4-bit cpu (X)	404418	34649	C4040	1	1	
U10	IC, CMOS, standard memory interface (X)	404434	34649	P4289	1	1	
U13	IC, CMOS, quad 2-input NOR gate (X)	355172	04713	MC14001CP	1	1	
U14	Res network, 4.7k	387100	89536	387100	1	1	
U15, U16	IC, TTL, 1-of-10 decoder	408716	01295	SN74L42N	1	1	
U17	Res network, 2k	446880	89536	446880	1	1	
U18	IC, CMOS, dual J-K flip-flop (X)	355230	04713	MC14027CP	1	1	
U19, U31	IC, PMOS, 320-bit RAM, 4-bit output (X)	404467	34649	P4002-2	2	1	
U20, U21	IC, PMOS, 320-bit RAM, 4-bit output (X)	404442	34649	P4002-1	2	1	
U22, U23	IC, TTL, hex inverter, open collector	394536	01295	SN74LS05	2	1	
U24	IC, CMOS, triple 3-input NOR gate (X)	355180	04713	MC14025CP	1	1	
U25	Res network, 10k	364000	89536	364000	1	1	
U26	IC, COS/MOS, hex buffer/converter (X)	404681	95303	CD4069B	1	1	
U27	IC, CMOS, hex buffer (X)	407759	12040	MM80C97N	1	1	
U28	Res network, 22k	376962	89536	376962	1	1	
U29	IC, CMOS, dual 4-input NAND gate (X)	355206	04713	MC14012CP	1	1	
U30	IC, CMOS, quad 2 input NAND gate (X)	413211	07263	34011PC	1	1	
U32	IC, TTL, quad 2-input NOR gate	393041	01295	SN74LS02	1	1	
Y1	Crystal, 5.185 MHz	408518	89536	408518	1	1	
	Socket, IC, 24-pin (use with U9)	418970	91506	324-AG39D	6		
	Socket, IC, 40-pin (use with U10)	418988	91506	340-AG39D	1		
	Socket, IC, 16-pin (use with U19, U20, U21)	276535	91506	316-AG39D	5		

A4 GUARD CROSSING PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A4	GUARD CROSSING PCB ASSEMBLY (2200A-4004T) Figure 8-12	409458	89536	409458	REF		
C1 thru C7, C9, C10, C11, C13	Cap, cer, 5000 pF $\pm$ 20%, 100V	175232	56289	C023B101- E502M	11		
C8	Cap, cer, 100 pF $\pm$ 10%, 1 KV	105593	71590	DD101	1		
C12, C14	Cap, Ta, 10 μ F $\pm$ 20%, 35V	330662	56289	196D106X- 0035KA1	2		
C20, C21	Cap, Ta, 0.22 μ F $\pm$ 20%, 35V	161331	56289	196D224X- 0035HA1	2		
O1 thru O23	Xstr, Si, NPN	218396	04713	2N3904	23	5	
R1, R7, R8, R11, R14	Res, comp, 1K $\pm$ 5%, $\frac{1}{4}$ W	148023	01121	CB1025	5		
R2 thru R5	Res, comp, 3K $\pm$ 5%, $\frac{1}{4}$ W	193508	01121	CB3025	4		
R6, R9, R10	Res, comp, 330 $\pm$ 5%, $\frac{1}{4}$ W	147967	01121	CB3315	3		
R12, R13	Res, comp, 2.2K $\pm$ 5%, $\frac{1}{4}$ W	148049	01121	CB2225	2		
R15, R16	Res, comp, 150 $\pm$ 5%, $\frac{1}{4}$ W	147934	01121	CB1515	2		
R20	Res, comp, 22K $\pm$ 5%, $\frac{1}{4}$ W	348870	01121	CB2235	1		
R21	Res, mf, 100K $\pm$ 1%, 1/8W	248807	91637	MFF1-81003F	1		
R22	Res, comp, 200K $\pm$ 5%, $\frac{1}{4}$ W	248781	01121	CB2045	1		
U1, U10, U14, U18, U20, U35	IC, TTL, triple 3-input positive NAND gate	393157	01295	SN74LS107N	6	2	
U2	IC, TTL, quad 2-input positive AND gate	393066	01295	SN74LS08N	1	1	
U3	IC, TTL, quad D-type flip-flop	408203	12040	DM85LS1N	1	1	
U4 thru U7	IC, TTL, BCD counter with latch	408195	12040	DM85LS2N	4	1	
U8	IC, COS/MOS, quad bilateral switch	363838	95303	CD4016AE	1	1	

A4 GUARD CROSSING PCB ASSEMBLY (cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U9, U32, U37, U39, U40	Opto-Isolator	387076	50579	ILD74	5	1	
U11	IC, TTL, quad 2-input NAND gate	393033	01295	SN74LS00N	1	1	
U12, U27	IC, TTL, triple 3-input NAND gate	393074	01295	SN74LS10N	2	1	
U13	IC, TTL, quad 2-input exclusive -OR gate	408237	01295	SN74LS86N	1	1	
U15, U30, U50	IC, COS/MOS, hex buffer/converter ⊗	381848	95303	CD4049AE	3	1	
U16	IC, CMOS, dual 4-bit static shift register ⊗	340125	04713	MC14015CP	1	1	
U17, U24, U43, U46, U47	IC, CMOS, dual D-type flip-flop ⊗	340117	04713	MC14013L	5	1	
U19, U29	IC, TTL, dual D-type flip-flop	393124	01295	SN74LS74N	2	1	
U21	IC, TTL, triple 3-input NOR gate	393090	01295	SN74LS27N	1	1	
U22, U25	IC, TTL, quad 2-input NOR gate	393041	01295	SN74LS02N	2	1	
U23, U26	IC, TTL, hex inverter	393058	01295	SN74LS04N	2	1	
U28	IC, TTL, dual one-shot	404186	01295	SN74LS123LN	1	1	
U31, U44	Res, network	408310	89536	408310	2	1	
U33, U41	Res, network	408302	89536	408302	2	1	
U34	IC, TTL, decade counter	402545	01295	SN74LS90N	1	1	
U36, U52	Res, network	408294	89536	408294	2	1	
U38	Opto-Isolator	380014	50522	MCT2	1	1	
U42, U49	IC, COS/MOS, quad 2-input NOR gate ⊗	355172	95303	CD4001AC	2	1	
U45	IC, CMOS, strobed hex inverter ⊗	408211	04713	MC14502CP	1	1	
Y1	See Final Assembly						
XY1	Socket Crystal	148668	91506	8000-AG10	1	1	

A5 PRINTER DRIVE PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A5	PRINTER DRIVE PCB ASSEMBLY (2200A-4007) Figure 8-5	409482	89536	409482	REF		
C1, C2, C3, C4, C6, C9	Cap, cer, 50,000 pF $\pm$ 20%, 100V	149161	56289	55C23A1	6		
C5, C8	Cap, cer, 10,000 pF $\pm$ 20%, 100V	149153	56289	C023B101F- 103M	2		
C7	Cap, elect, 330 μ F -10/+50%, 16V	187765	73445	ET331X016- A02	1	1	
C10 thru C14	Cap, cer, 25,000 pF $\pm$ 20%, 100V	168435	56289	C023B101H- 253M	4		
Q1	Xstr, Si, NPN	218396	04713	2N3904	1	1	
R1	Res, comp, 5.1K $\pm$ 5%, $\frac{1}{4}$ W	193342	01121	CB5125	1		
R2, R3 R4, R7	Res, comp, 1K $\pm$ 5%, $\frac{1}{4}$ W	148023	01121	CB1025	2		
R5, R8	Res, comp, 12K $\pm$ 5%, $\frac{1}{4}$ W	159731	01121	CB1235	2		
R6, R9	Res, comp, 2K $\pm$ 5%, $\frac{1}{4}$ W	202879	01121	CB2025	2		
U1, U26	IC, TTL, hex inverter	393058	01295	SN74LS04N	2	1	
U2, U5, U7, U18	IC, TTL, dual D-type flip-flop	393124	01295	SN74LS74N	2	1	
U3	IC, TTL, dual J-K flip-flop	414029	01295	SN74LS112N	1	1	
U4	IC, TTL, triple 3-input NOR gate	393090	01295	SN74LS27N	1	1	
U6	IC, TTL, quad 2-input NOR gate	393041	01295	SN74LS02N	1	1	
U8, U9	IC, TTL, 8-bit parallel out serial shift register	408732	01295	SN74LS164N	2	1	
U10	IC, COS/MOS, hex buffer 	355412	95303	CD4010AE	1	1	
U11	IC, COS/MOS, hex inverter 	355214	95303	CD4009AE	1	1	
U12	IC, TTL, triple 3-input NAND gate	393074	01295	SN74LS10N	1	1	
U13	IC, TTL, quad 2-input NAND gate	393033	01295	SN74LS00N	1	1	
U14 thru U17, U20 thru U24	IC, TTL, dual peripheral NAND driver	329706	01295	SN75452P	9	2	
U19, U27	IC, Lin, Comparator	352195	01295	SN72311P	2	1	
U25	IC, CMOS, hex tri-state buffer 	407759	04713	MC14503CP	1	1	

A5 PRINTER DRIVE PCB ASSEMBLY (cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	Pin, contact	424135	27264	09-64-1152	1		
	Socket, IC, 14-pin	387316	71785	133-59-02-059	2		

A6 DISPLAY PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A6	DISPLAY PCB ASSEMBLY (2240A-4008T) Figure 8-6	409656	89536	409656	REF		
C3	Cap, cer, 100 pF $\pm$ 10%, 1 KV	105593	71590	DD-101	1		
C4	Cap, Ta, 39 μ F $\pm$ 20%, 6V	163915	56287	196D396X- 0006KA1	1		
C5	Cap, elect, Ta, 33 μ F $\pm$ 10%, 10V	182832	56289	150D336X- 9010B2	1	1	
CR1, CR2, CR3, CR7, CR17	Diode, Si, switching	313247	28480	HP5082-6264	5	1	
CR4, CR5, CR6, CR8 thru CR16	Diode, Si, switching	203323	07910	1N4448	12	3	
CR18, CR19, CR20, CR21	Diode, light-emitting	428623	12040	59NSL-5046	4	1	
DS1 thru DS9	LED, display, 7-segment	418012	28480	5082-7651	9	2	
J43	Socket, IC, 14-pin	387316	71785	133-59-02-059	1		
Q1, Q2, Q3, Q5 thru Q11	Xstr, Si, PNP	352369	12040	2N4403	10	2	
R1, R2, R5, R7, R25	Res, comp, 68 $\pm$ 5%, $\frac{1}{4}$ W	414532	01121	CB6805	5		
R3	Res, comp, 6.8k $\pm$ 5%, $\frac{1}{4}$ W	368761	01121	CB6825	1		
R11, R13, R17, R19, R23	Res, comp, 51 $\pm$ 5%, $\frac{1}{4}$ W	414540	01121	CB5105	5		
R29	Res, comp, 33 $\pm$ 5%, $\frac{1}{4}$ W	414524	01121	CB3305	1		
U1, U4	IC, TTL, BCD-to-7-segment decoder/driver	340109	01295	SN7447AN	2	1	
U2, U5	Res, network	344069	89536	344069	2	1	
U3, U6, U8	IC, TTL, BCD-to-decimal decoder/driver	293175	01295	SN74145N	3	1	
U7	IC, TTL, quad 2-input NOR gate	393041	01295	SN74LS02N	1	1	
U9	Res, network	364018	89536	364018	1	1	

A6 DISPLAY PCB ASSEMBLY (cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U10, U11	Res, network	414557	89536	414557	2	1	
	Socket, display LED	387316	71785	133-59-02-059	9		
	Socket, annunciator LED	436055	22526	65358-001	4		

A7 MODE SWITCH PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A7	MODE SWITCH PCB ASSEMBLY (2240A-4009T) Figure 8-7	409664	89536	409664	REF		
C1	Cap, Ta, 22 μ F $\pm$ 20%, 25V	357780	56289	196D220X- 0025PE4	1		
C2	Cap, film, 0.0047 μ F $\pm$ 10%, 100V	106054	56289	192P47202	1		
J41	Conn, PCB	414375	27264	09-52-3151	1		
J42	Socket, 14-pin	387316	71785	133-59-02-059	1		
R1	Res, carbon film, 47k $\pm$ 5%, 1/4W	348896	80031	CR251-45P47- KTS	1		
U1	IC, TTL, synchronous 4-bit binary up/down counter	393231	01295	SN74LS193N	1	1	
U2	IC, CMOS, dual J-K flip-flop 	355230	04713	MC14027CP	1	1	
U3, U8, U13	IC, COS/MOS, hex, inverter 	381848	86684	CD4050AE	3	1	
U4	IC, TTL, one-shot mv	293134	04713	MC9601P	1	1	
U5	IC, TTL, 64-bit (4 x 16) read/write memory	408583	01295	SN7489N	1	1	
U6, U10	Res, network	352054	89536	352054	2	1	
U7	IC, CMOS, dual 4-input NOR gate 	363820	04713	MC14002CP	1	1	
U9	IC, COS/MOS, triple 3-input OR gate 	408575	86684	CD4075BE	1	1	
U11	IC, TTL, dual J-K flip-flop	393157	01295	SN74LS107N	1	1	
U12, U19	IC, TTL, quad 2-input NAND gate	393033	01295	SN74LS00N	2	1	
U14, U17	IC, COS/MOS, hex buffer/converter 	381830	86684	CD4049AE	2	1	
U15, U16	IC, CMOS, hex tri-state buffer 	407759	04713	MC14503CP	2	1	
U18	IC, CMOS, quad 2-input NOR gate 	355172	04713	MC14001CP	1	1	
U20	Res, network	408310	89536	408310	1	1	
1	Pushbutton, switch	412163	89536	412163	13		
2	Switch assembly	408526	89536	408526	1	1	
	Spacer, switch-to-pcb	295246	71590	J64286	11		

A8 KEYBOARD SWITCH PCB ASSEMBLY (cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A8	KEYBOARD SWITCH PCB ASSEMBLY (2240A-4011T) Figure 8-8	409672	89536	409672	REF		
C1	Cap, plstc, 0.1 μ F $\pm$ 20%, 250V	161992	89536	161992	1		
CR1, CR3 thru CR13	Diode, light-emitting	428623	12040	59NSL-5046	12	3	
P44, P45	Pin, contact	380683	27264	09-64-1121	2		
Q1	Xstr, Si, PNP	203364	07263	S37234	1	1	
R1, R2, R3	Res, comp 12k $\pm$ 5%, $\frac{1}{4}$ W	159731	01121	CB1235	3		
R4, R6 thru R12	Res, comp, 100 $\pm$ 5%, $\frac{1}{4}$ W	147926	01121	CB1015	8		
R5	Res, comp, 680 $\pm$ 5%, $\frac{1}{4}$ W	148007	01121	CB6815	1		
R13	Res, comp, 8.2k $\pm$ 5%, $\frac{1}{4}$ W	160796	01121	CB8225	1		
R14	Res, comp, 10m $\pm$ 5%, $\frac{1}{4}$ W	194944	01121	CB1065	1		
R15	Res, comp, 2.4m $\pm$ 5%, $\frac{1}{4}$ W	221945	01121	CB2455	1		
U1	IC, TTL, 4-to-16 line decoder	408351	12040	MM74C154N	1	1	
U2, U3	IC, TTL, hex inverter, with open-collector outputs	288605	01295	SN7416N	2	1	
U4	IC, CMOS, triple 3-input NOR gate 	355172	04713	MC14025CP	1	1	
1	Pushbutton, blue	406876	89536	406876	1		
2	Pushbutton, grey	406819	89536	406819	17		
3	Pushbutton, orange	420620	89536	420620	1		
4	Pushbutton, white	406884	89536	406884	11		
5	Actuator, switch	412106	89536	412106	30		
6	Contact, switch	416875	00779	62380-4 & 62313-4	30		
7	Contact spring, switch	414516	00779	62353-3 & 62312-3	30		
8	Cover, switch	401299	89536	401299	30		
9	Spacer, swaged	380352	89536	380352	7		
10	Socket, 2-contact	436055	22526	65358-001	12		

A9 KEYBOARD LOGIC PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A9	KEYBOARD LOGIC PCB ASSEMBLY (2240A-4012T) Figure 8-9	409680	89536	409680	REF		
C1	Cap, film, 0.22 μ F $\pm$ 10%, 50V	271577	06001	75F1R5A223	1		
C2, C5	Cap, Ta, 10 μ F $\pm$ 20%, 10V	176214	56289	196D106X- 0010KA1	2		
C3	Cap, Ta, 2.2 μ F $\pm$ 10%, 15V	364216	56289	196D222X- 9015HA1	1		
C4	Cap, cer, 1000 pF $\pm$ 10%, 500V	357806	71590	CF-102	1		
C6	Cap, cer, 100 pF $\pm$ 10%, 1 kV	105593	71590	DD-101	1		
J35	Socket, IC, 16-pin	276535	91506	316AG39D	1		
J44, J45	Connector, female, 12-pin	380691	27264	09-52-3122	2		
J49	Conn, post	379438	00779	86144-5	2		
LS1	Speaker	339879	72653	TYPE S2-203	1		
Q1, Q2	Xstr, Si, PNP	203364	07263	S37234	2	1	
Q3, Q4	Xstr, Si, NPN	218396	04713	2N3904	2	1	
Q5	Xstr, Si, NPN	381798	04713	MPSA-13	1	1	
R1, R2, R4, R14	Res, comp, 680 $\pm$ 5%, $\frac{1}{4}$ W	148007	01121	CB6815	4		
R3	Res, comp, 1M $\pm$ 5%, $\frac{1}{4}$ W	182204	01121	CB1055	1		
R5	Res, comp, 62 $\pm$ 5%, $\frac{1}{4}$ W	261842	01121	CB6205	1		
R6	Res, comp, 39 $\pm$ 5%, $\frac{1}{4}$ W	193391	01121	CB3905	1		
R7	Res, comp, 47k $\pm$ 5%, $\frac{1}{4}$ W	148163	01121	CB4735	1		
R8	Res, comp, 16k $\pm$ 5%, $\frac{1}{4}$ W	221606	01121	CB1635	1		
R9	Res, comp, 150k $\pm$ 5%, $\frac{1}{4}$ W	182212	01121	CB1545	1		
R10	Res, comp, 100k $\pm$ 5%, $\frac{1}{4}$ W	148189	01121	CB1045	1		
R11	Res, comp, 200k $\pm$ 5%, $\frac{1}{4}$ W	248781	01121	CB2045	1		
R13, R15, R16, R17	Res, comp, 8.2k $\pm$ 5%, $\frac{1}{4}$ W	160796	01121	CB8225	4		
U1, U14	IC, COS/MOS, hex inverter 	381848	86684	CD4049AE	2	1	
U2	IC, COS/MOS, quad 2-input OR gate 	408393	86684	CD4071BE	1	1	

A9 KEYBOARD LOGIC PCB ASSEMBLY (cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U3	IC, CMOS, dual binary to 1-of-4 decoder (X)	408369	04713	MC14556CP	1	1	
U4	IC, COS/MOS, quad 2-input AND gate (X)	408401	86684	CD4081BE	1	1	
U5, U12, U16	IC, CMOS, dual D-type flip-flop (X)	340117	12040	MM5613AN	3	1	
U6, U7	IC, CMOS, hex buffer (X)	407759	12040	MM80C97N	2	1	
U8, U9, U15	IC, TTL, 4-bit bistable latch	408377	01295	SN74LS75N	3	1	
U10	IC, COS/MOS, quad 2-input NOR gate (X)	355172	86684	CD4001AE	1	1	
U11	IC, COS/MOS, dual complementary pair plus inverter (X)	408013	86684	CD4007AE	1	1	
U13	IC, COS/MOS, triple 3-input NAND gate (X)	375147	86684	CD4023AE	1	1	
U17	IC, TTL, one-shot mv	404186	01295	SN74LS123N	1	1	
1	Bracket, speaker	415224	89536	415224	1		

A10 KEYBOARD MEMORY PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A10	KEYBOARD MEMORY PCB ASSEMBLY (2240A-4013T) Figure 8-10	409698	89536	409698	REF		
C1	Cap, Ta, 10 μ F $\pm$ 20%, 15V	193623	56289	196D106X- 0015KA1	1		
C2	Cap, cer, 50,000 pF $\pm$ 20%, 100V	149161	56289	55C23A1	1		
CR1	Diode, Si switching	203323	07910	1N4448	1	1	
J2, J8, J10	Socket, IC, 14-pin	387316	71785	133-59-02-059	3		
J36	Socket, IC, 16-pin	276535	91506	316AG39D	1		
Q1, Q2	Xstr, Si, NPN	218081	04713	MPS6520	2	1	
Q3	Xstr, FET, N-channel	370072	89536	370072	1	1	
R1, R2, R4 thru R18, R26, R27	Res, comp, 6.8k $\pm$ 5%, $\frac{1}{4}$ W	148098	01121	CB6825	19		
R3, R24	Res, comp, 15k $\pm$ 5%, $\frac{1}{4}$ W	148114	01121	CB1535	2		
R19, R20, R21, R22, R28	Res, comp, 47k $\pm$ 5%, $\frac{1}{4}$ W	148163	01121	CB4735	5		
R23	Res, comp, 30k $\pm$ 5%, $\frac{1}{4}$ W	193417	01121	CB3035	1		
R25	Res, comp, 1k $\pm$ 5%, $\frac{1}{4}$ W	108597	01121	CB1025	1		
U1, U2	IC, CMOS, 16 x 4 RAM $\otimes$	408385	12040	MM74C89N	2	1	
U9, U14, U15	IC, CMOS, tri-state hex buffer $\otimes$	407759	12040	MM80C97N	3	1	
U10	IC, CMOS, bcd to decimal decoder $\otimes$	407981	12040	MM74C42N	1	1	
U13	IC, COS/MOS, hex inverter $\otimes$	381848	86684	CD4049AE	1	1	

A11 RANGE AND FUNCTION MEMORY PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A11	RANGE AND FUNCTION MEMORY PCB ASSEMBLY (2240A-4032T) Figure 8-11	412445	89536	412445	REF		
C1	Cap, elect 10 μ F -10/+50%, 25V	170266	73445	ET100X025A2	1	1	
C2	Cap, Ta, 10 μ F $\pm$ 20%, 20V	330662	56289	196D106X- 0020KA1	1		
C3, C4	Cap, mica, 56 pF $\pm$ 5%, 500V	148528	72136	DM15F560J	2		
C5	Cap, cer, 0.1 μ F $\pm$ 20%, 100V	149146	56289	33C41B6	1		
CR1, CR2	Diode, Si, switching	203323	07910	1N4448	2	1	
Q1 thru Q18	Xstr, Si, NPN	218396	04713	2N3904	18	4	
R1	Res, comp, 200 $\pm$ 5%, $\frac{1}{4}$ W	193482	01121	CB2015	1		
R2, R3	Res, mf, 20k $\pm$ 1%, $\frac{1}{8}$ W	291872	91637	MFF1-82002F	2		
R4 thru R11	Res, comp, 10k $\pm$ 5%, $\frac{1}{4}$ W	148106	01121	CB1035	8		
R12	Res, comp, 1k $\pm$ 5%, $\frac{1}{4}$ W	148023	01121	CB1025	1		
R13	Res, comp, 3.3k $\pm$ 5%, $\frac{1}{4}$ W	148056	01121	CB3325	1	1	
U1, U2	Res, network	364000	89536	364000	2	1	
U3	Res, network	355305	89536	355305	1	1	
U4, U5, U9, U23, U24	IC, CMOS, hex inverters $\otimes$	355214	04713	MC14009CP	5	1	
U8, U15, U25	IC, COS/MOS, triple 3-input NAND gate $\otimes$	375147	86684	CD4023AE	3	1	
U16	IC, CMOS, triple 3-input NOR gate $\otimes$	355180	04713	MC14025CP	1	1	
U20	IC, COS/MOS, 4-stage parallel in/out shift register $\otimes$	414078	86684	CD4035AE	1	1	
U21	IC, CMOS, tri-state hex buffer $\otimes$	407759	12040	MM80C97N	1	1	
U22, U31	IC, CMOS, quad 2-input NAND gate $\otimes$	355198	04713	MC14011CP	2	1	
U26, U36, U37	IC, CMOS, dual J-K flip-flop $\otimes$	355230	04713	MC14027CP	3	1	

A11 RANGE AND FUNCTION MEMORY PCB ASSEMBLY (cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U27, U28, U30, U34, U35, U38	IC, CMOS, dual D-type flip-flop (X)	340117	12040	MM5613AN	6	2	
U29	IC, CMOS, hex buffers (X)	355412	04713	MC14010CP	1	1	
U32	IC, CMOS, dual 4-input NOR gate (X)	363820	04713	MC14002CP	1	1	
U33	IC, CMOS, dual 4-input NAND gate (X)	355206	04713	MC14012CP	1	1	
U39, U40	IC, CMOS, quad 2-input NOR gate (X)	355172	04713	MC14001CP	2	1	
VR1	Diode, zener	340695	12969	UZ8710	1	1	
XU10 thru XU12, XU17 thru XU19, XU29	Socket, IC, 16-pin	276535	91506	316AG39D	7		

Section 6

Option & Accessory Information

6-1. INTRODUCTION

6-2. This section of the manual contains information concerning the options and accessories available for use with the Model 2240B. It consists of an introductory section, an accessories subsection and a series of option subsections. All options and accessories are listed by model or option number in the table of contents. Corresponding subsection page numbers and other documentation location information are also listed.

6-3. Hardware type accessories, i.e., rack mounting kits and cables, are documented in the accessories subsection. However, the more complex accessories, (scanner chassis) are documented in stand-alone manuals which are provided with the purchased instrument.

6-4. The most commonly used options are documented herein as individual subsections. Each subsection contains all of the information necessary to install, operate, and maintain the option. This includes a list of replaceable parts and a schematic.

6-5. The less commonly used options are also documented as subsections. However, their documentation is supplied with the purchased option, and is added to Section 6 of this manual.

6-6. The location of a particular subsection is facilitated by the use of unique page and paragraph numbering which corresponds to the option or accessory in question. For example, a 600-x series identifies the general accessories subsection and a 605-x series identifies the subsection for the —05 option (where x is the sequential page or paragraph numbers).

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OPTION/ MODEL NO.	DESCRIPTION	DOCUMENTATION SUPPLIED:	PAGE NO.
ACCESSORIES			
MO7-205-600	Rack Mounting Kit	Herein	600-1
MOO-280-610	Rack Slide Kit	Herein	600-1
2200A-7005	Service Extender Cable Set	Herein	600-1
2200A-7006	General Purpose Interface Cable (6-foot)	Herein	600-1
2200A-7007	Interface Connector, Blank (50-pin)	Herein	600-2
2201A	Scanner Chassis	With 2201A	
2202A	Remote Scanner Chassis	With 2202A	
2203A	RTD Scanner Chassis	With 2203A	
OPTIONS			
—01	Not Used	—	
—02	Not Used	—	
—03	RTD Connector	With 2203A	
—04	RTD Scanner	With 2203A	
—05	General Purpose Scanner	Herein	605-1
—06	Low Level Scanner	Herein	606-1
—07	Solder Pin Connector	Herein	607-1
—08	Isothermal Block Connector	Herein	608-1
—09	A/D Converter, General Purpose	Herein	609-1
—10	A/D Converter, High Performance	Herein	610-1
—11	Temperature Measurement and Scaling	Herein	611-1
—12 Series	TTY/RS-232C Interface	With Option	612-1
—13 Series	Paper Tape Punch Interface	With Option	613-1
—14 Series	Magnetic Tape Interface	With Option	614-1
—15	Not Used	—	
—16	Digital Input Interface	With Option	616-1
—17	Remote Programming Interface	With Option	617-1
—18	Not Used	—	
—19	Not Used	—	
—20	Not Used	—	
—21	Not Used	—	
—22	Alarm Set, 15 Single Limits	With Option	622-1
—23	Alarm Set-Point Output	With Option	623-1
—24	Not Used	—	
—25	Custom Scaling	With Option	625-1
—26	Multiple Custom Scaling	With Option	626-1
—27	Engineering Units	With Options	627-1
—28	Current Transmitter, 1-5 mA	With Options	628-1
—29	Current Transmitter, 0-20 mA	With Option	629-1
—30	Current Transmitter, 10-50 mA	With Option	630-1

ACCESSORIES

600-1. RACK MOUNTING KIT (MO7-205-600)

600-2. The data logger can be rack-mounted in a 24-inch deep equipment rack using the Rack Slide Kit MOO-280-610. Use the following procedure to install the kit:

- a. Peel off the name plate decals from the front side-corners of the data logger
- b. Remove the front corner screws which match the hole pattern in the rack-mounting ears (see Figure 600-1).

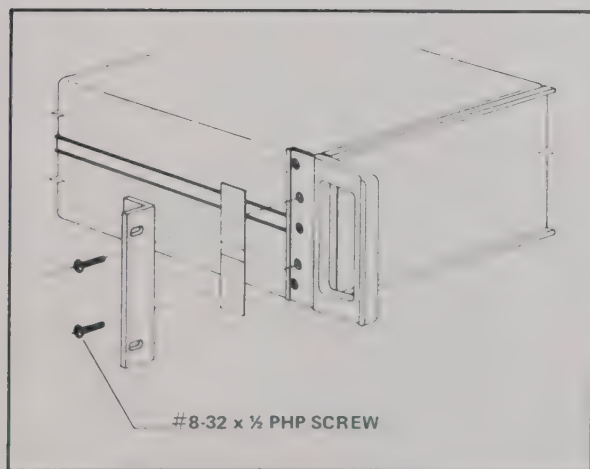


Figure 600-1. Rack Mounting Kit

- c. Attach the rack-mounting ears to the front corners of the unit using the screws supplied in the rack-mounting kit.

600-3. RACK SLIDE KIT (MOO-280-610)

600-4. The data logger can be rack-mounted in a standard 19-inch equipment rack using Rack Mounting Kit MO7-205-600. Use the following procedure to install the kit.

- a. Remove the horizontal side trim decal from both sides of the data logger.
- b. Refer to Figure 600-2, and, using the screws supplied with the kit, attach the Chassis Section (B) of the slide kit to each side of the unit. Use the center row of mounting holes.
- c. Install the cabinet Section (D) and the Center Section (C) in the equipment rack.
- d. Pull the Center Section of the slide out through the front of the equipment rack until it locks in the extended position.
- e. Depress the spring locks on the Chassis Section (B) and join section B and C.
- f. Push the instrument into the equipment rack and then pull it out to the extended position. The spring locks should limit the rack slide travel.

600-5. SERVICE EXTENDER CABLE SET (2200A-7005)

600-6. A set of two service extender cables is available for use in servicing any one of the data logger's vertical plug-in pcbs. The majority of the pcb's require the use of only one extender. However, some of the pcb's, such as the A/D Converter, require the use of both extenders.

600-7. GENERAL PURPOSE INTERFACE CABLE (2200A-7006)

600-8. The General Purpose Interface Cable is designed for use in fabricating custom I/O cables for the Digital Input Option (—16) and the Alarm Set-Point Output Option (—23). The cable assembly consists of a

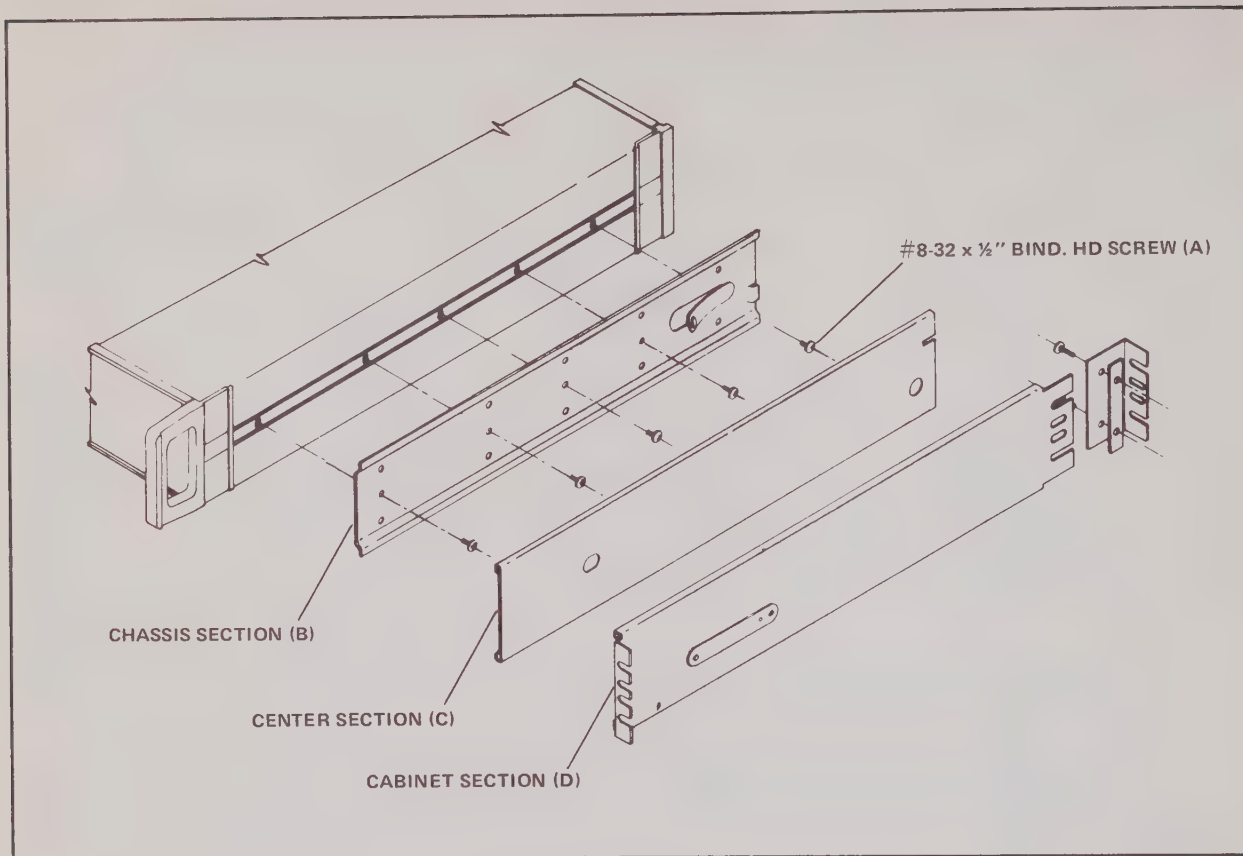


Figure 600-2. Rack Slide Kit

6-foot, 50-wire cable and a 50-pin connector. The connector is attached to one end of the cable and is designed to mate with the rear-panel connectors on Options —16 and —23. The user is responsible for completing the connections at the free-end of the cable. Refer to the appropriate option (—16 or —23) in this section of the manual for the necessary connector pin assignments.

600-9. INTERFACE CONNECTOR (2200A-7007)

600-10. The Interface Connector is designed for use in fabricating custom I/O cables for the Digital Input Option (—16) and the Alarm Set-Point Option (—23). The connector assembly consists of a blank 50-pin connector and a hood. The user is responsible for the remainder of the cable. Refer to the appropriate option (—16 or —23) in this section of the manual for the necessary connector pin assignments.

600-11. FAN-FOLD PRINTER PAPER (2010A-7013)

600-12. Fan fold paper suitable for use with the data logger's internal printer is available from the John Fluke Mfg. Co., Inc. The paper is supplied in packages containing 1-dozen packets. Therefore, when ordering, specify model number 2010A-7013 and indicate a quantity of 1 for each dozen packets required. (See Section 2 for paper installation instructions.)

600-13. PRINTER RIBBON (2010A-7014)

600-14. Two-color (red and black) printer ribbon suitable for use with the data logger's internal printer is available from the John Fluke Mfg. Co., Inc. The ribbon is supplied in packages containing 1-dozen spools. Therefore, when ordering, specify model number 2010A-7014 and indicate a quantity of 1 for each dozen spools required. (See Section 2 for printer ribbon installation instructions.)

Option —09

General Purpose A/D Converter

609-1. INTRODUCTION

609-2. The General Purpose A/D Converter (Option —09) is a factory installed, plug-in pcb assembly that operates in conjunction with the Guard Crossing PCB Assembly to form a programmable, two-range (4V and 400 mV), dual-slope, a/d converter. Both ranges are programmed via the Guard Crossing and include a 40,000 count full-scale output capability. As a result, 10 μ V can be accurately resolved on the 400 mV range.

609-3. When the General Purpose A/D Converter is used in conjunction with the Temperature and Scaling Option (—11), direct-reading thermocouple temperature measurements are possible. Temperature scales, selected via the data loggers' front panel controls, permit measurement resolution of $\pm 1^\circ\text{C}$ or $^\circ\text{F}$.

609-4. SPECIFICATIONS

609-5. Specifications for the General Purpose A/D Converter are contained in Section 1 of this manual.

609-6. OPERATIONS

609-7. Once installed in the data logger, the General Purpose A/D Converter requires no operator attention other than ensuring that the input voltages present at the measurement channels are compatible with the measurement function selected for the A/D Converter. Instructions for selecting range and function are contained in Section 2 of this manual.

609-8. THEORY OF OPERATION

609-9. General

609-10. The General Purpose A/D Converter PCB operates in conjunction with the Guard Crossing PCB to perform the analog functions of a two-range (400 mV and 4V), dual-slope integrating DVM capable of resolving 10 μ V on the 400 mV range. Digital program and control

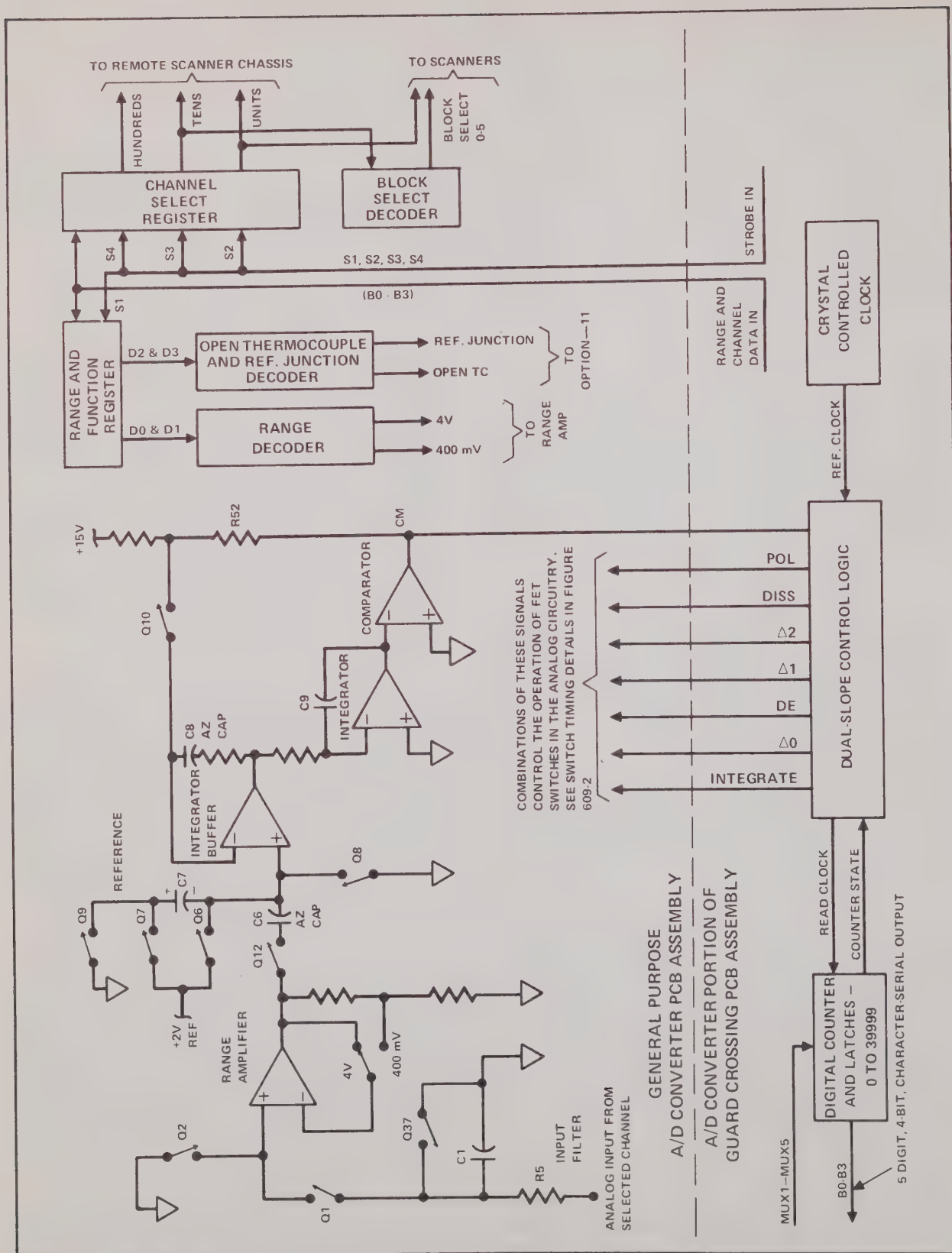
data necessary to complete a measurement cycle (this includes the read clock) are generated on the Guard Crossing PCB. Similarly a 40,000 count counter string is included on the Guard Crossing for accumulating the digital equivalent of the measured analog input. After measurement data is accumulated it is presented to the Data Bus in character serial format when solicited by the Controller. A simplified block diagram of the General Purpose A/D Converter plus the associated digital logic from the Guard Crossing is given in Figure 609-1. A detailed schematic of the General Purpose A/D Converter PCB Assembly is shown in Figure 609-4.

609-11. Digital Control Logic

609-12. Digital control logic for the General Purpose A/D Converter is contained on both the Guard Crossing PCB and the a/d converter pcb. A/D conversion logic on the Guard Crossing PCB consists of a crystal controlled clock, a digital counter with latches and multiplexed tri-state outputs and dual-slope digital control logic. Digital logic on the General Purpose A/D Converter PCB consists of four addressable four-bit registers and three output decoders. All digital input data utilized by the digital control logic is received from the Controller via the Guard Crossing PCB Assembly.

609-13. Operation of the guard crossing logic is synchronized with the output of the crystal controlled clock. The clock, in turn, is synchronized with the line frequency to optimize the common mode and normal mode rejection characteristics of the a/d converter. This is accomplished by installing either a 2 MHz or 2.4 MHz crystal for 50 or 60 Hz line frequencies, respectively. Additional clock circuitry in the form of pulse shaping dividers produce the final 2ϕ reference clock as received by the dual-slope control logic.

609-14. Overall timing of the dual-slope conversion process is governed directly by the dual-slope control logic. Two control flip-flops (U14B/FFA and U20A/FFB) operate in response to the carry outputs of the various counter stages and the reference clock to



determine the next state of the dual-slope control logic and, therefore, its output control signals. These signals are shown in Figure 609-2 and described in Table 609-1.

609-15. The data accumulated in the digital counter (if ≤ 39999) is determined to be the digital equivalent of the analog input voltage when the CM (compare) input from the a/d converter pcb transitions to a state which is the opposite of the POL (polarity) level. This transition indicates the end of the a/d conversion and causes the counter data to be loaded into the output latches. It also initiates a Data Ready signal which is transmitted across the guard as part of the status word.

609-16. When the Controller detects the Data Ready status it generates a series of five Strobe In pulses which are converted on the Guard Crossing PCB into a series of

five multiplexer pulses, MUX1 through MUX5. As each pulse sequentially occurs, one of the five 4-bit counter characters is solicited, transferred across the guard crossing, and placed onto the Controller's Data Bus. The entire five measurement digits (this includes polarity and overload indications as part of the MSD) must be transmitted across the guard before the next measurement cycle is allowed to start (i.e., the reference clock is inhibited until MUX5 goes low to indicate that the last digit of measurement data has been solicited).

609-17. Channel select data for measurement purposes is updated once during each a/d conversion (measurement) cycle so that new analog data can be presented to the a/d converter. Updating occurs in response to an interrupt status signal generated by the Guard Crossing PCB. The interrupt causes the Controller to specify the next programmed measurement channel and its

Table 609-1. Guard Crossing Signal Descriptions

SIGNAL NAME	DESCRIPTION
Int + $\Delta 1$	A 21000 count period derived directly from control flip-flop FFB (U20A). Used for controlling FET switching on the A/D Converter PCB.
$\Delta 1$	A 1000 count period which starts when FAA and FFB are both low and the counter has reached a count of 19999. The period ends when the counter three least-significant stages go through a count of 999. At this time the fourth stage is prevented from clocking so that the clock pulse will change the counter from 20999 to 20000. This signals the beginning of the integrate period.
$\Delta 0$	A 10 count period immediately following the end of the integrate period. During this time the second counter stage is inhibited so that the count goes from 39999 to 00009 and then to 00000. Thus, after a 10 count settling period the read period starts at a count of 00000 and continues on. The count at the end of the read period is proportional to the analog input voltage.
POL	Indicates the polarity of the integrated input signal, and is derived from the level (high or low) of the CM signal at the end of the integrate period.
$\Delta 2$	A 2 ms pulse generated at the end of the integrate period. It is used by the Temperature and Scaling Option —11 to trigger and open thermocouple detector.
Diss	An 8.8 ms pulse generated at the end of $\Delta 2$. It is used to discharge the input filter before the next analog input is applied and to prevent the closing of more than 1 scanner relay at a time.
DE	A variable length read period which begins at the end of the $\Delta 0$ pulse. The end of the read period occurs when the CM pulse transitions to a state that is different from POL or when the counter counts through 19999 after an overload reading of 39999.
$\downarrow$ (Overload)	An overload signal (1-bit) which is returned to the controller with the MSD of measurement data. The signal occurs when the counter counts through 39999 before a CM input transition occurs, and prevents the counter MSD from going from 19999 to 20000. Instead, the counter transitions from 19999 to 00000. This allows an extra 20000 count auto-zero period to ensure full recovery from the overload condition.

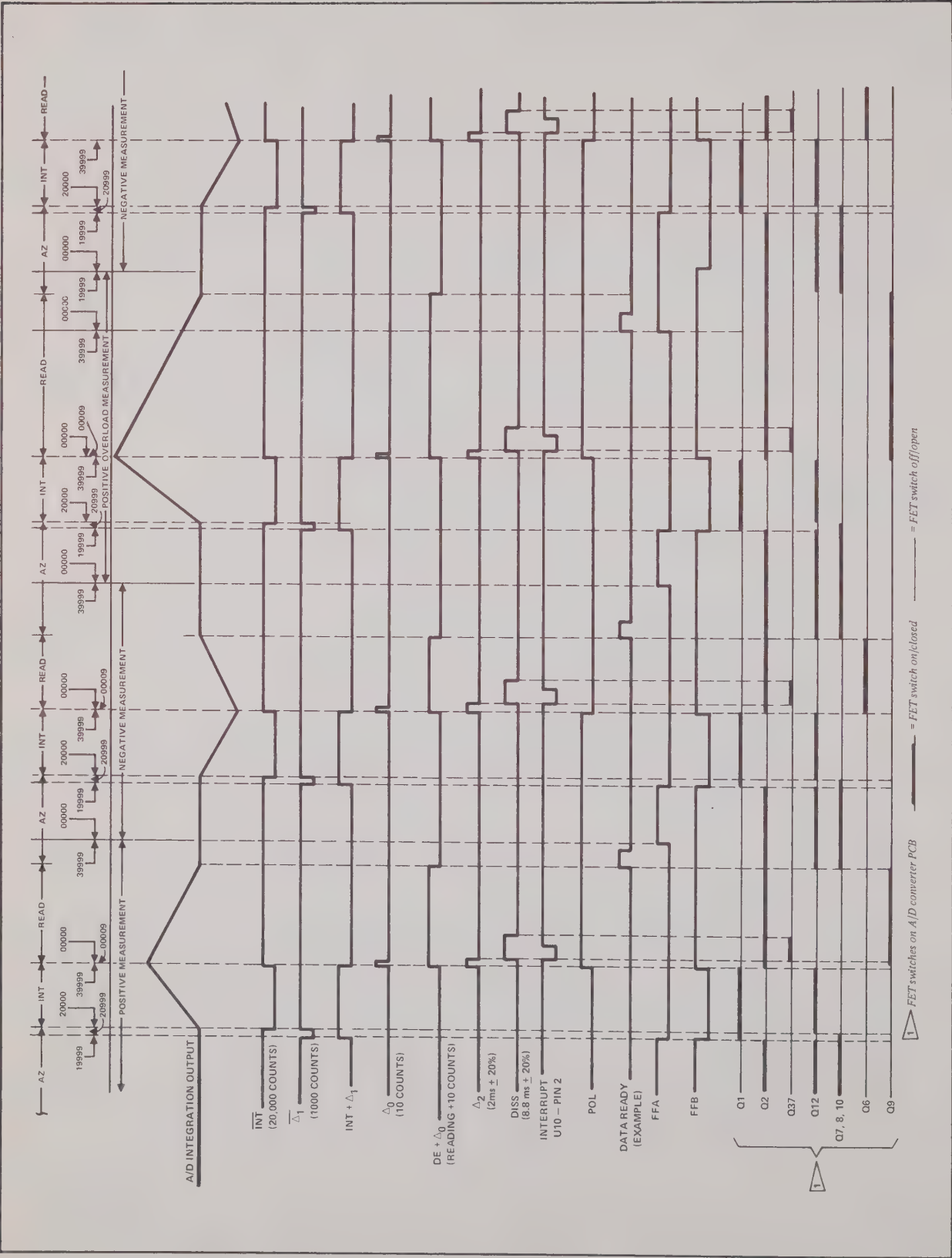


Figure 609-2. A/D Converter Timing Diagram

associated function data to the Guard Crossing PCB. Data is received as a series of four 4-bit characters which are serially transferred across the guard to the A/D Converter PCB. A unique strobe pulse (S1 through S4) accompanies each character and causes it to be entered into a four bit register. The first character is entered into a range and function register by strobe pulse S1. The second, third and fourth characters are similarly entered into a series of three channel select registers by strobe pulses S2, S3 and S4, respectively.

609-18. Range and function data for the next measurement cycle are derived from the first stored character. Its two low-order bits D0 and D1 are decoded to provide the range command (4V or 400 mV) for the Range Amplifier on the a/d converter pcb. Similarly, open-thermocouple detect and reference-junction measure commands are decoded from the two high-order bits, D2 and D3.

609-19. Channel select commands (units, tens and hundreds) are taken directly from the output of the three channel select registers. Tens data is decoded to provide the individual block select commands for the first 60 (0-59) channels in the data logger, while units data activates the appropriate channel relay (0-9) in the selected scanner block. Channel commands above 59 (60 through 999) are available at a rear-panel connector on the a/d converter pcb for use in selecting channels maintained in an external scanner chassis (2201A, 2202A and/or 2203A).

609-20. Analog Circuit

609-21. The analog portion of the dual-slope a/d converter is contained entirely on the General Purpose A/D Converter PCB Assembly. It consists of an input filter, a range amplifier, a reference supply, an integrator buffer, an integrator, a comparator and a series of FET switches. Digital control signals from the Guard Crossing PCB control the operation of the FET switches and, therefore, the overall operation of the analog circuit. Figure 609-2 relates the operation of each individual FET switch to the digitally controlled measurement cycle.

609-22. Operation of any given measurement cycle can be logically divided into three measurement periods; auto zero, integrate, and read. Auto zero is used to measure and eliminate any in circuit errors which might influence the end reading. During integrate the input signal is sampled (integrated) for a known time period. During the read period two separate functions are performed. The next analog input is applied to the input filter for settling purposes, and the previously sampled (integrate) input voltage is compared (integrated) against a reference voltage. The time required to

complete the read period is then translated, by the dual-slope control logic, into a digital equivalent of the analog input voltage.

609-23. The auto zero period begins at the end of the read period, as indicated by the leading edge of the Data Ready pulse. At that time FET switches Q1, Q37, Q6 and Q9 are open and Q2, Q7, Q8, Q10 and Q12 are closed. Switch Q1 isolates the input of the range amplifier from the analog level present at the input filter. Switches Q2 and Q8 provide a zero volt reference levels for charging a series of reference capacitors C6, C7 and C8. Capacitor C6 charges through Q8 and Q12 to a value which is equal to the offset voltage error inherent in the Range Amplifier. Similarly, capacitor C8 is charged through switch Q10 to a value which is equal to the loop offset voltage of the integrator buffer, integrator and comparator combination. Finally, capacitor C7 is charged to the +2V reference level through switches Q7 and Q8. The charges on these capacitors will be retained throughout the remainder of the measurement cycle for use in eliminating offset errors (C6 and C8), and providing the choice of selectable reference polarity (C7) which is compatible with the analog input signal.

609-24. Termination of the auto zero period occurs in two steps. First switches Q2 and Q12 are opened and switch Q1 is closed. This isolates the range amplifier output from the rest of the circuit and allows it to respond to the input voltage applied through switch Q1. Second, switches Q7, Q8 and Q10 are opened and switch Q12 is closed. This connects the output of the range amplifier to the integrator buffer. At this time the auto zero period is ended and the integrate period begins.

609-25. During the integrate period the integrator buffer presents the integrator with an offset corrected dc input voltage which is equivalent to the analog input voltage level. This signal is then integrated for a fixed time which is equal to 20,000 read-clock pulses, as determined by the digital counters on the Guard Crossing PCB. When the time period is satisfied the integrate period is ended and the read period is started.

609-26. At the start of the read period switches Q1 and Q12 are opened, and Q2 and either Q6 or Q9 are closed. Switches Q1, Q2 and Q12 electrically remove the range amplifier and, therefore, the analog input signal from the input of the integrator buffer. If the input signal was positive, switch Q9 is closed and a -2 volt reference is applied to the integrator buffer via the previously charged reference capacitor C7. However, if the original analog input signal was negative, switch Q6 is closed causing the +2 volt reference to be applied directly to the input of the integrator buffer. In either event, integrator capacitor C9 begins to discharge at a fixed

linear rate, and the counter string on the Guard Crossing PCB begins to count and accumulate the reference clock output. The discharge continues until the capacitor reaches a zero-charge level as determined by the previous auto-zero period. When that level is detected by the comparator, a compare (CM) transition is generated to terminate the read period. This stops the counter on the Guard Crossing PCB and returns the analog circuitry to the auto-zero period. (The next measurement cycle starts after data is transferred across the guard to the Controller.)

609-27. Since the range amplifier and the input filter are isolated from the rest of the analog circuit at the beginning of the read period, both digital range data and the analog input signal for the next measurement channel are entered at that time. This allows both the input filter and the range amplifier to settle before the next measurement cycle begins.

609-28. MAINTENANCE

609-29. Access/Disassembly

609-30. The A/D Converter is accessed by removing the top dust cover, and the inner guard cover from the data logger. The position of the A/D Converter in the data logger is shown in Figure 609-3. Access to the calibration adjustments does not require the removal of the inner guard cover.

CAUTION

Handle the A/D Converter PCB by its edges to avoid contaminating it with oil from the hands. The use of gloves is recommended.

609-31. To remove the A/D Converter from the data logger, remove the inner guard cover and disconnect the rear-panel scanner chassis cable which attaches to the data logger. (This cable is present only if the data logger is equipped with the Scanner Chassis, Model 2201A, 2202A or 2203A.) Pull the A/D Converter PCB straight up and out through the top of the data logger.

609-32. Calibration

609-33. The General Purpose A/D Converter should be calibrated when the data logger is calibrated or after major repairs have been made to the pcb. A DC Calibrator and a DVM are required for calibration. The recommended instruments are listed in Section 4, Table 4-1. The calibration adjustments and test points are all located on the A/D Converter PCB, and are shown in Figure 609-1. Use the following procedure to calibrate the A/D Converter:

609-6

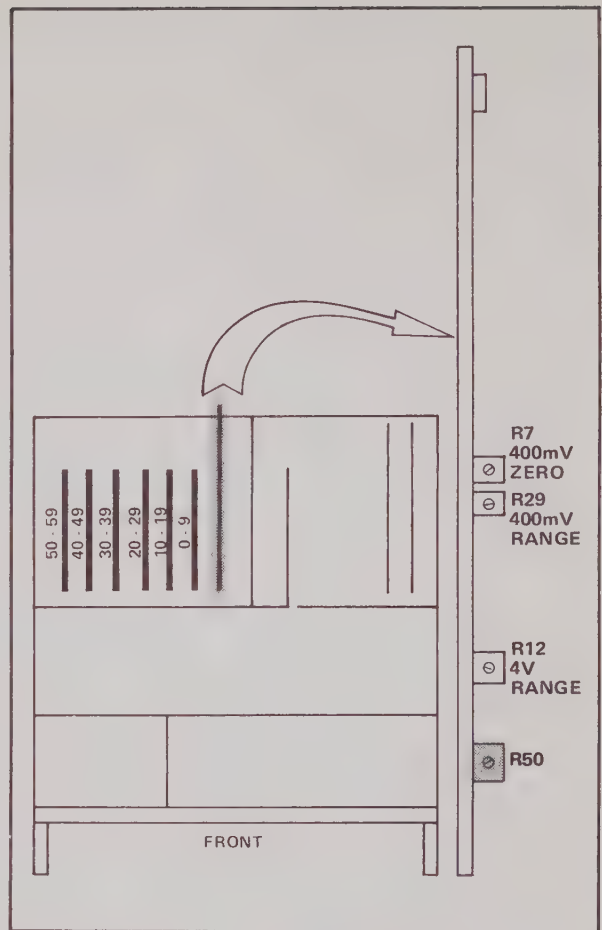


Figure 609-3. General Purpose A/D Converter Test Point and Adjustment Locations

CAUTION

Turn power off before removing or installing pcb's.

- a. De-energize the data logger and press the STOP/RESET switch in the SCAN CONTROL switch group.
- b. Install a Scanner pcb (Option —05 or —06) in scanner slot 0 of the data logger.
- c. Set the output of the DC Calibrator to 0V, and, using a Solder Pin Connector (Option —07), connect the output of the DC Calibrator to channel 0 of the scanner in slot 0.
- d. Energize the data logger and program it to perform the following scan sequence:
 1. Monitor Channel 00
 2. Function = 400 mV

- e. Press the MONITOR switch and adjust the 400 mV ZERO pot (R7) for a zero indication, i.e., the display alternates between a + and - polarity indication. Ignore the digital display.

NOTE

Under normal conditions steps f through j may be omitted from the calibration procedure. However, if the A/D Converter has been repaired prior to calibration, component parts have been replaced, or potentiometers R50 has been inadvertently adjusted the steps must be executed.

- f. Remove the inner guard cover and mount the A/D Converter on extender cables.
- g. Program the data logger for the 4V function and set the DC Calibrator for a +1 mV output.
- h. Adjust R50 for a display of 0.0010V.
- i. Reverse the polarity of the DC Calibrator output. The display should read -0.0010V.

- j. Remove the extender cables, mount the A/D Converter in its slot, and install the inner guard cover.
- k. Set the output of the DC Calibrator to 3.0000 volts, and adjust R12 for a reading of 3.0000 on the data logger display.
- l. Reverse the polarity of the DC Calibrator output. The display should read -3.0000 ± 0.0002 V.
- m. Set the DC Calibrator output to +300 mV.
- n. Program the data logger function to 400 mV and adjust R29 for a display of 300.00 mV.

609-34. LIST OF REPLACEABLE PARTS

609-35. A list of replaceable parts for the General Purpose A/D Converter PCB Assembly is given in Table 609-2. Refer to Section 5 of this manual for ordering information.



CAUTION

Indicated devices are subject to damage by static discharge.

Table 609-2. General Purpose A/D Converter PCB Assembly, Option -09

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
-09	GENERAL PURPOSE A/D CONVERTER PCB ASSEMBLY, OPTION -09 (2200A-4005T) Figure 609-4						
C1, C9	Cap, poly pro, 0.47 μ F $\pm 10\%$, 50V	363085	84411	JF86	2		
C3, C17	Cap, mica, 4 pF $\pm 0.5\%$, 200V	190397	72136	DM15C004D	2		
C4, C5, C18, C19	Cap, cer, 500 pF $\pm 10\%$, 1 kV	105692	71590	2DDH60N501K	4		
C6, C7, C8	Cap, poly car, 2.2 μ F $\pm 10\%$, 250V	306522	73445	C280MCH/ A2M2	3		
C10	Cap, cer, 0.0027 μ F GMV, 600V	106211	56289	5GA-D33	1		
C11, C12, C13	Cap, Ta, 10 μ F $\pm 20\%$, 20V	330662	56289	196D106X- 0020KA1	3		
C22	Cap, cer, 0.005 μ F $\pm 20\%$, 50V	255471	51642	200-050-601- 502M	1		

Table 609-2. General Purpose A/D Converter PCB Assembly, Option —09 (Continued)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED PLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
CR2, CR7, CR8, CR9	Diode, Si, switch	203323	07910	1N4448	4	1	
J29	Socket, IC, 14-pin, DIP	387316	71785	133-59-02-059	1		
Q1 thru Q4, Q8, Q9, Q10, Q12, Q21, Q22, Q35, Q36, Q37	Xstr, J-FET, N-channel	357905	89536	357905	13	3	
Q6, Q7	Xstr, FET, N-channel	376475	89536	376475	2	1	
Q13, Q14	Xstr, FET, dual, N-channel	379321	89536	379321	2	1	
Q19	Xstr, Si, NPN	218396	04713	2N3904	1	1	
R5	Res, comp, $39k \pm 10\%$, 2W	424721	01121	HB3931	1		
R7	Res, var, $50k \pm 10\%$, $\frac{1}{2}W$	288290	89536	288290	1	1	
R8	Res, mf, $2k \pm 1\%$, $\frac{1}{8}W$	277137	91637	MFF1-82001F	1		
R9, R10, R15, R19, R45, R57	Res, comp, $22k \pm 5\%$, $\frac{1}{4}W$	148130	01121	CB2235	1		
R11, R13	(See VR5)						
R12	Res, var, $500 \pm 10\%$, $\frac{1}{2}W$	291120	89536	291120	1	1	
R14, R56	Res set, 20k/40k	416339	89536	416339	1	1	
R16	Res, mf, $23.7k \pm 1\%$, $\frac{1}{8}W$	188367	91637	MFF2372F	1		
R17, R18	Res, mf, $15k \pm 1\%$, $\frac{1}{8}W$	285296	91637	MFF1502F	2		
R27	Res, comp, $2M \pm 5\%$, $\frac{1}{4}W$	268771	01121	CB2055	1		
R28, R31	Res set, 20k/2.22k	416347	89536	416347	1	1	
R29	Res, var, $2k \pm 10\%$, $\frac{1}{2}W$	285163	89536	285163	1	1	
R30	Res, mf, $402k \pm 1\%$, $\frac{1}{8}W$	217984	91637	MFF1-84023F	1	1	
R41	Res, comp, $2.2k \pm 5\%$, $\frac{1}{4}W$	148049	01121	CB2225	1		
R42, R43	Res, mf, $6.81k \pm 1\%$, $\frac{1}{8}W$	268417	91637	MFF1-86811-F	2		
R47, R49	Res, mf, $75k \pm 1\%$, $\frac{1}{8}W$	291443	91637	MFF1-87502F	2		
R50	Res, var, $200 \pm 10\%$	285148	89536	285148	1	1	
R51	Res, comp, $820k \pm 5\%$, $\frac{1}{4}W$	220541	01121	CB8245	1		

Table 609-2. General Purpose A/D Converter PCB Assembly, Option —09 (Concluded)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R52	Res, comp, 680k $\pm$ 5%, 1/4W	188433	01121	CB6845	1		
R53	Res, comp, 1.5k $\pm$ 5%, 1/4W	148031	01121	CB1525	1		
R61	Res, comp, 10k $\pm$ 5%, 1/4W	148106	01121	CB1035	1		
R62	Res, comp, 82 $\pm$ 5%, 1/4W	149484	01121	CB8205	1		
R63	Res, comp, 1k $\pm$ 5%, 1/4W	148023	01121	CB1025	1		
R64	Res, comp, 470 $\pm$ 5%, 1/4W	147983	01121	CB4715	1		
R83	Res, comp, 100M $\pm$ 5%, 1/2W	190520	01121	EB1075	1		
R84	Res, comp, 100k $\pm$ 5%, 1/4W	148189	01121	CB1045	1		
U1, U2	IC, linear, op amp	404087	49956	RC4739DP	2		
U3	IC, linear, op amp	352195	12040	LM311PA	1	1	
U4	IC, linear, voltage regulator, 15V	419044	49956	RC4195T	1	1	
U6	IC, TTL, quad 2-input AND gate	412759	12040	DM8819N	1	1	
U7	IC, transistor array, 7 drivers	413237	56289	UAT-4236	1	1	
U13	IC, TTL, dual J-K flip-flop	393157	01295	SN74LS107N	1	1	
U14	IC, TTL, dual 2 line-to-4 line decoder	393165	01295	SN74LS139N	1	1	
U15 thru U18	IC, CMOS quad D-latch	412742	12040	MM74C173N	4	1	
U19	IC, CMOS, 8-input OR gate	418798	12040	MM4048AN	1	1	
U20	IC, CMOS, 1-of-10 decoder	380741	86684	CD4028AE	1	1	
U21	IC, CMOS, hex buffer/inverter	381830	86684	CD4050AE	1	1	
U22	IC, TTL, quad 2 input exclusive NOR gate	393033	01295	SN74LS266N	1	1	
U23, U24	Res, network, 100k	412726	89536	412726	2	1	
VR5	Reference voltage set (matched components)	377283	89536	377283	1		
VR6, VR10	Diode, zener, 5.6V	277236	89536	277236	2	1	
	Socket, IC, 14-pin DIP	276527	89536	276527	2		

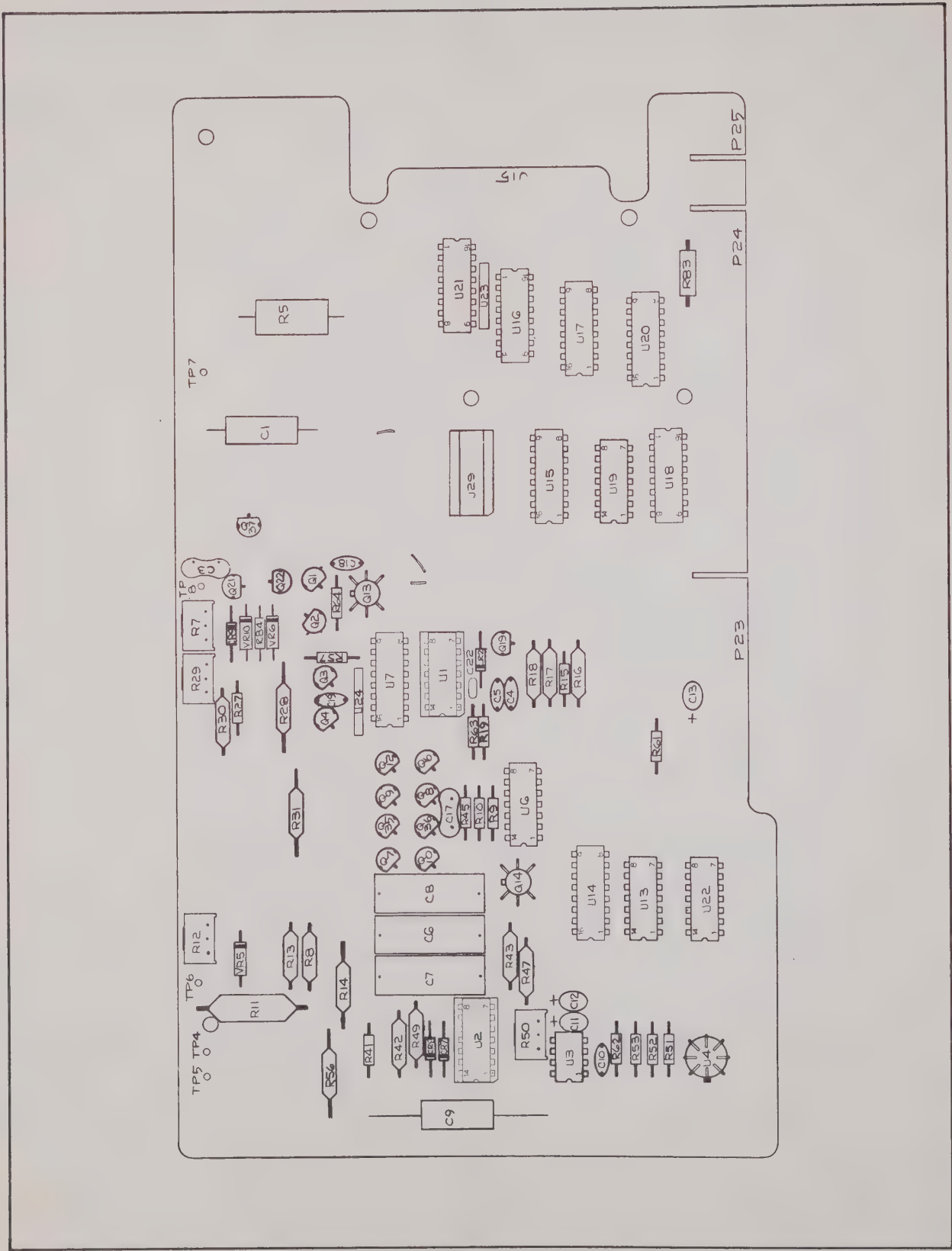


Figure 609-4. General Purpose A/D Converter PCB Assembly, Option -09 (2200A-1005) (Sheet 1 of 2)

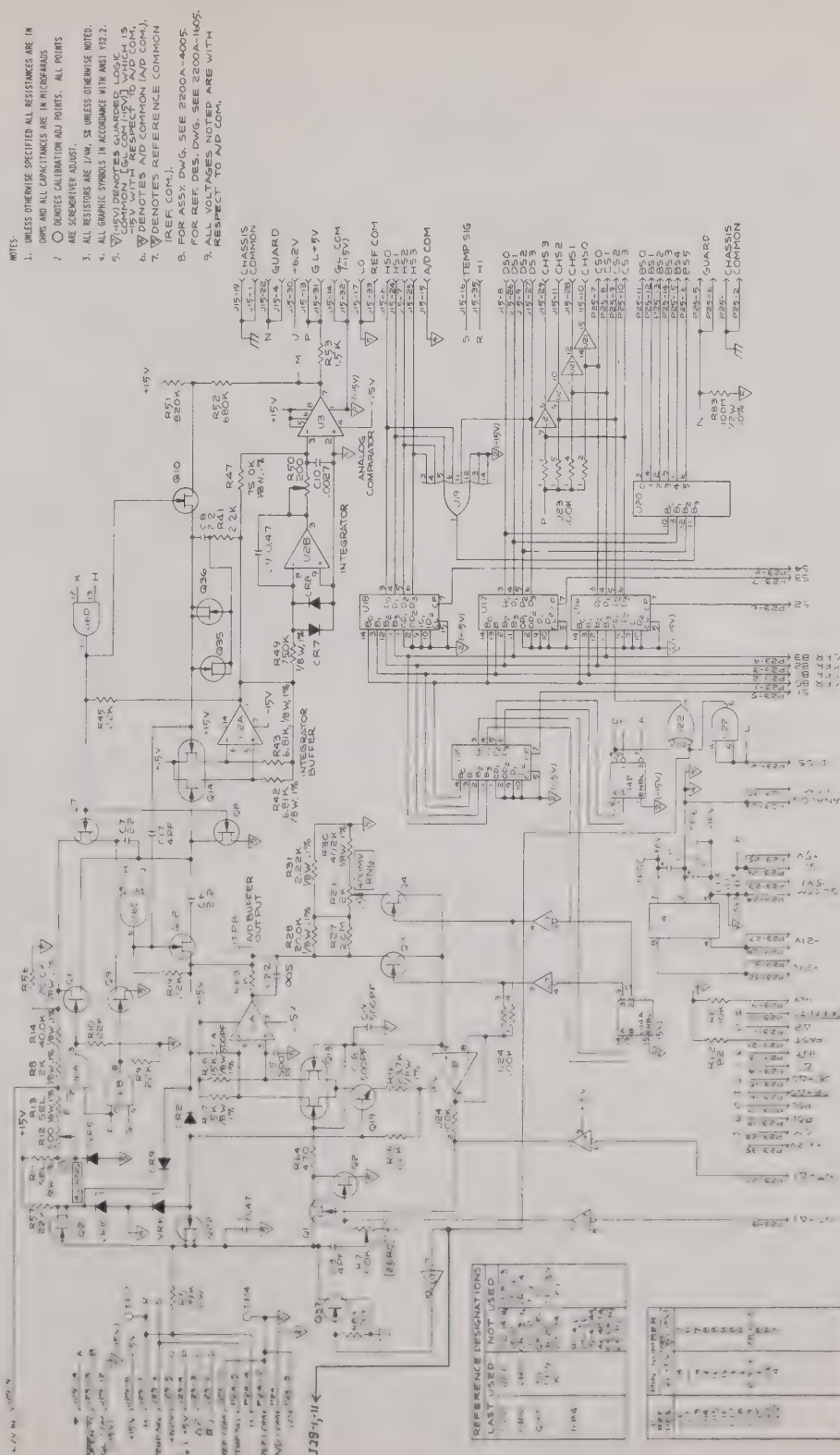


Figure 609-4. General Purpose A/D Converter PCB Assembly, Option -09 (2200A-1005) (Sheet 2 of 2)

Option —10 High Performance A/D Converter

610-1. INTRODUCTION

610-2. The High Performance A/D Converter (Option —10) is a factory installed, plug-in pcb assembly that operates in conjunction with the Guard Crossing PCB Assembly to form a programmable four range (40 mV, 400 mV, 4V and 40V), dual-slope a/d converter. All four ranges can be programmed via the Guard Crossing, and include a 40,000 count full scale output capability. As a result, 1 μ V can be accurately resolved on the 40 mV range.

610-3. When the High Performance A/D Converter is used in conjunction with the Temperature and Scaling Option (—11), direct-reading thermocouple temperature measurements are possible. Temperature scales, selected via the data logger's front panel controls, offer measurement resolution of $\pm 0.1^\circ\text{C}$ or $^\circ\text{F}$.

610-4. SPECIFICATIONS

610-5. Specifications for the High Performance A/D Converter are contained in Section 1 of this manual.

610-6. OPERATION

610-7. Once installed in the data logger, the High Performance A/D Converter requires no operator attention other than ensuring that the input voltages present at the measurement channels are compatible with the measurement functions selected for the A/D Converter. Instructions for selecting range and function are contained in Section 2 of this manual.

610-8. The measurement speed of the High Performance A/D Converter can be set by the operator for either 3 (slow) or 15 (fast) readings per second. The selection of measurement speed is accomplished by setting a slide switch on the A/D Converter PCB to the fast or slow position. The access procedure, the switch location, and the switch settings are described later under maintenance.

610-9. THEORY OF OPERATION

610-10. General

610-11. The High Performance A/D Converter PCB operates in conjunction with the Guard Crossing PCB to perform the analog functions of a five-range (40V, 4V, 400 mV, 80 mV and 40 mV), dual-slope, integrating DVM capable of resolving 1 μ V on the 40 mV range. Digital program and control data necessary to complete a measurement cycle (this includes the read clock) are generated on the Guard Crossing PCB. Similarly, a 40,000 count counter string is included on the Guard Crossing PCB for accumulating the digital equivalent of the measured analog input. After measurement data is accumulated, it is presented to the Data Bus in character-serial format when solicited by the Controller. A simplified block diagram of the High Performance A/D Converter plus the associated digital logic from the Guard Crossing is given in Figure 610-1. A detailed schematic of the High Performance A/D Converter PCB Assembly is shown in Figure 610-4.

610-12. Digital Control Logic

610-13. Digital control logic for the High Performance A/D Converter is contained on both the Guard Crossing PCB and the a/d converter pcb. A/D conversion logic on the Guard Crossing PCB consists of a two-speed crystal controlled clock, a digital counter with latches and multiplexed tri-state outputs, and dual-slope digital control logic. Digital logic on the High Performance A/D Converter PCB consists of four addressable four-bit registers and three output decoders. All digital input data utilized by the digital control logic is received from the Controller via the Guard Crossing PCB Assembly.

610-14. Operation of the guard crossing logic is synchronized with the output of the crystal controlled clock. The clock in turn is synchronized with the line frequency to optimize the common mode and normal

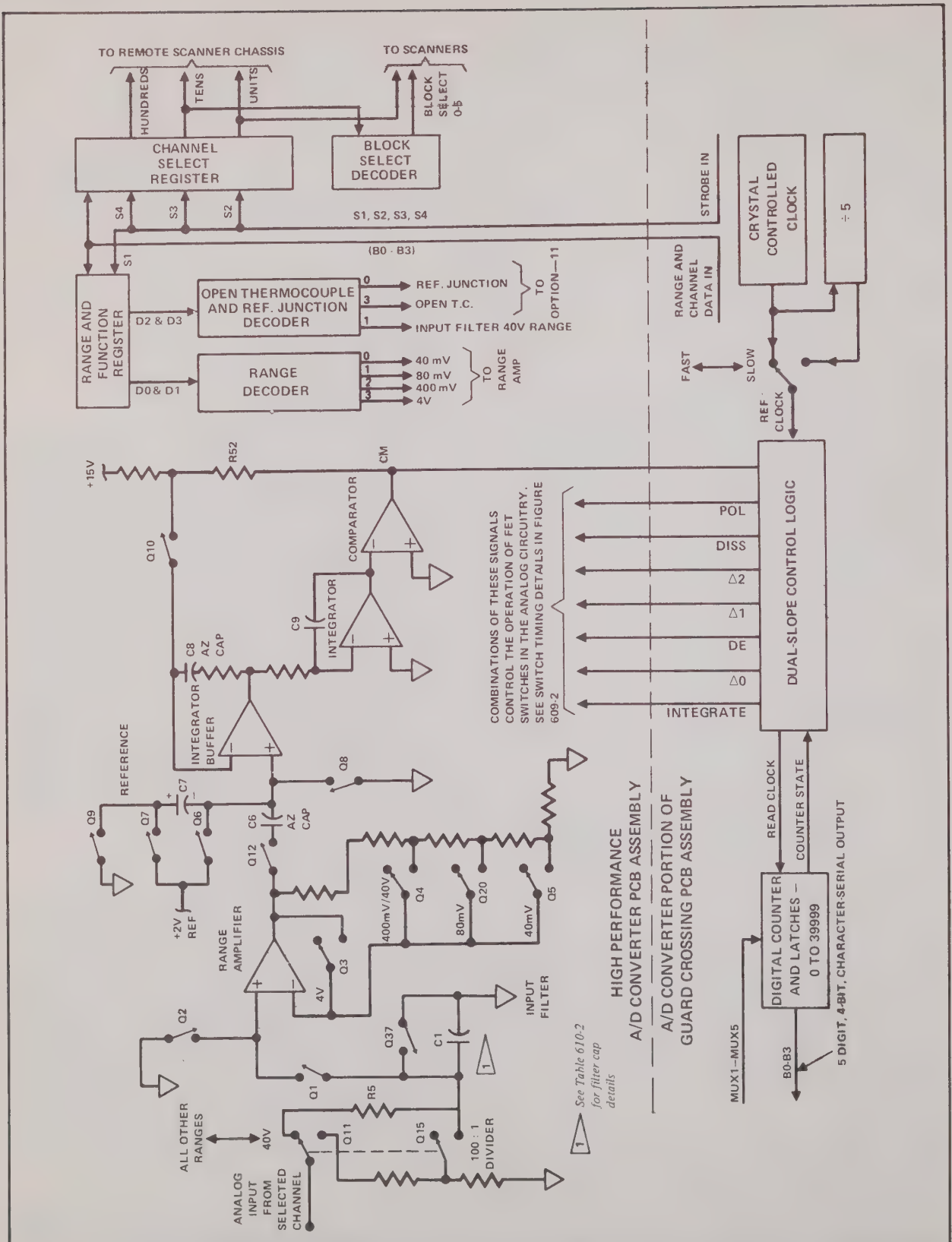


Figure 610-1. General Purpose A/D Converter PCB Assembly Functional Block Diagram

mode rejection characteristics of the a/d converter. This is accomplished by installing either a 2 MHz or 2.4 MHz crystal for 50 or 60 Hz line frequencies, respectively. Additional clock circuitry in the form of pulse shaping dividers produce the final 20 reference clock as received by the dual-slope control logic.

610-15. Clock rate (and, therefore, measurement speed) can be selected manually by positioning a FAST/SLOW slide switch on the a/d converter pcb. In the fast position a 1.2 MHz (60 Hz), 2-phase clock is supplied directly to the a/d converter logic. Since a measurement cycle requires 80,000 clock pulses to produce a reading, the a/d converter can accomplish a maximum of 15 readings per second. In the slow switch position the 1.2 MHz clock is divided by five. Thus, the measurement rate is reduced to three readings per second, maximum.

610-16. Overall timing of the dual-slope conversion process is governed directly by the dual-slope control logic. Two control flip-flops (U14B/FAA and U20A/FFB) operate in response to the carry outputs of the various counter stages and the reference clock to determine the next state of the dual-slope control logic and, therefore, its output control signals. These signals are shown in Figure 610-2 and described in Table 610-1.

610-17. The data accumulated in the digital counter (if ≤ 39999) is determined to be the digital equivalent of the analog input voltage when the CM (compare) input from the a/d converter pcb transitions to a state which is the opposite of the POL (polarity) level. This transition indicates the end of the read period and causes the counter data to be loaded into the output latches. It also initiates a Data Ready signal which is transmitted across the guard as part of the status word.

Table 610-1. Guard Crossing Signal Descriptions

SIGNAL NAME	DESCRIPTION
Int + $\Delta 1$	A 21000 count period derived directly from control flip-flop FFB (U20A). Used for controlling FET switching on the A/D Converter PCB.
$\Delta 1$	A 1000 count period which starts when FAA and FFB are both low and the counter has reached a count of 19999. The period ends when the counter three least-significant stages go through a count of 999. At this time the fourth stage is prevented from clocking so that the clock pulse will change the counter from 20999 to 20000. This signals the beginning of the integrate period.
$\Delta 0$	A 10 count period immediately following the end of the integrate period. During this time the second counter stage is inhibited so that the count goes from 39999 to 00009 and then to 00000. Thus, after a 10 count settling period the read period starts at a count of 00000 and continues on. The count at the end of the read period is proportional to the analog input voltage.
POL	Indicates the polarity of the integrated input signal, and is derived from the level (high or low) of the CM signal at the end of the integrate period.
$\Delta 2$	A 2 ms pulse generated at the end of the integrate period. It is used by the Temperature and Scaling Option —11 to trigger and open thermocouple detector.
Diss	An 8.8 ms pulse generated at the end of $\Delta 2$. It is used to discharge the input filter before the next analog input is applied and to prevent the closing of more than 1 scanner relay at a time.
DE	A variable length read period which begins at the end of the $\Delta 0$ pulse. The end of the read period occurs when the CM pulse transitions to a state that is different from POL or when the counter counts through 19999 after an overload reading of 39999.
L (Overload)	An overload signal (1-bit) which is returned to the controller with the MSD of measurement data. The signal occurs when the counter counts through 39999 before a CM input transition occurs, and prevents the counter MSD from going from 19999 to 20000. Instead, the counter transitions from 19999 to 00000. This allows an extra 20000 count auto-zero period to ensure full recovery from the overload condition.

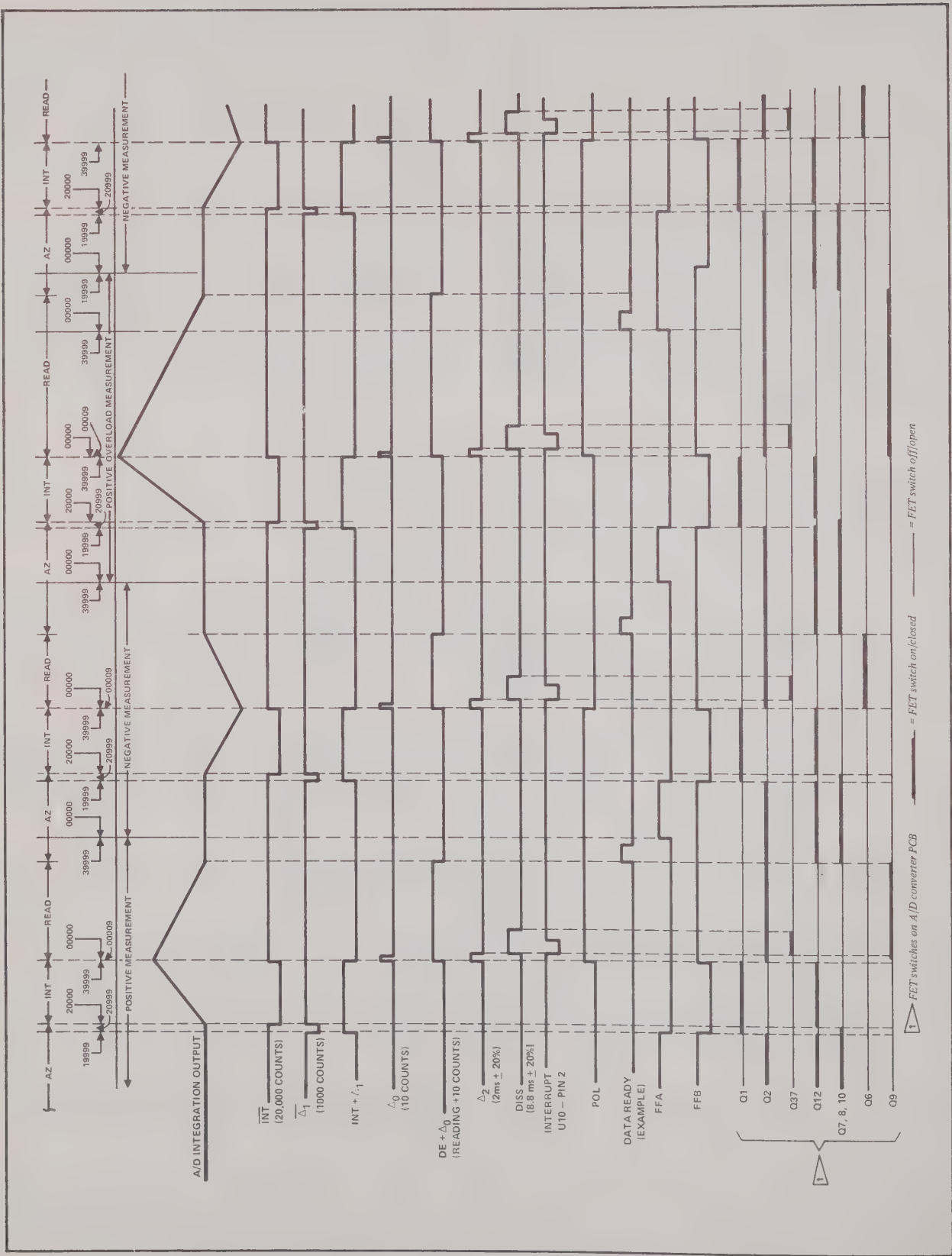


Figure 610-2. A/D Converter Timing Diagram

mode rejection characteristics of the a/d converter. This is accomplished by installing either a 2 MHz or 2.4 MHz crystal for 50 or 60 Hz line frequencies, respectively. Additional clock circuitry in the form of pulse shaping dividers produce the final 20 reference clock as received by the dual-slope control logic.

610-15. Clock rate (and, therefore, measurement speed) can be selected manually by positioning a FAST/SLOW slide switch on the a/d converter pcb. In the fast position a 1.2 MHz (60 Hz), 2-phase clock is supplied directly to the a/d converter logic. Since a measurement cycle requires 80,000 clock pulses to produce a reading, the a/d converter can accomplish a maximum of 15 readings per second. In the slow switch position the 1.2 MHz clock is divided by five. Thus, the measurement rate is reduced to three readings per second, maximum.

610-16. Overall timing of the dual-slope conversion process is governed directly by the dual-slope control logic. Two control flip-flops (U14B/FAA and U20A/FFB) operate in response to the carry outputs of the various counter stages and the reference clock to determine the next state of the dual-slope control logic and, therefore, its output control signals. These signals are shown in Figure 610-2 and described in Table 610-1.

610-17. The data accumulated in the digital counter (if ≤ 39999) is determined to be the digital equivalent of the analog input voltage when the CM (compare) input from the a/d converter pcb transitions to a state which is the opposite of the POL (polarity) level. This transition indicates the end of the read period and causes the counter data to be loaded into the output latches. It also initiates a Data Ready signal which is transmitted across the guard as part of the status word.

Table 610-1. Guard Crossing Signal Descriptions

SIGNAL NAME	DESCRIPTION
Int + $\Delta 1$	A 21000 count period derived directly from control flip-flop FFB (U20A). Used for controlling FET switching on the A/D Converter PCB.
$\Delta 1$	A 1000 count period which starts when FAA and FFB are both low and the counter has reached a count of 19999. The period ends when the counter three least-significant stages go through a count of 999. At this time the fourth stage is prevented from clocking so that the clock pulse will change the counter from 20999 to 20000. This signals the beginning of the integrate period.
$\Delta 0$	A 10 count period immediately following the end of the integrate period. During this time the second counter stage is inhibited so that the count goes from 39999 to 00009 and then to 00000. Thus, after a 10 count settling period the read period starts at a count of 00000 and continues on. The count at the end of the read period is proportional to the analog input voltage.
POL	Indicates the polarity of the integrated input signal, and is derived from the level (high or low) of the CM signal at the end of the integrate period.
$\Delta 2$	A 2 ms pulse generated at the end of the integrate period. It is used by the Temperature and Scaling Option —11 to trigger and open thermocouple detector.
Diss	An 8.8 ms pulse generated at the end of $\Delta 2$. It is used to discharge the input filter before the next analog input is applied and to prevent the closing of more than 1 scanner relay at a time.
DE	A variable length read period which begins at the end of the $\Delta 0$ pulse. The end of the read period occurs when the CM pulse transitions to a state that is different from POL or when the counter counts through 19999 after an overload reading of 39999.
$\overline{1}$ (Overload)	An overload signal (1-bit) which is returned to the controller with the MSD of measurement data. The signal occurs when the counter counts through 39999 before a CM input transition occurs, and prevents the counter MSD from going from 19999 to 20000. Instead, the counter transitions from 19999 to 00000. This allows an extra 20000 count auto-zero period to ensure full recovery from the overload condition.

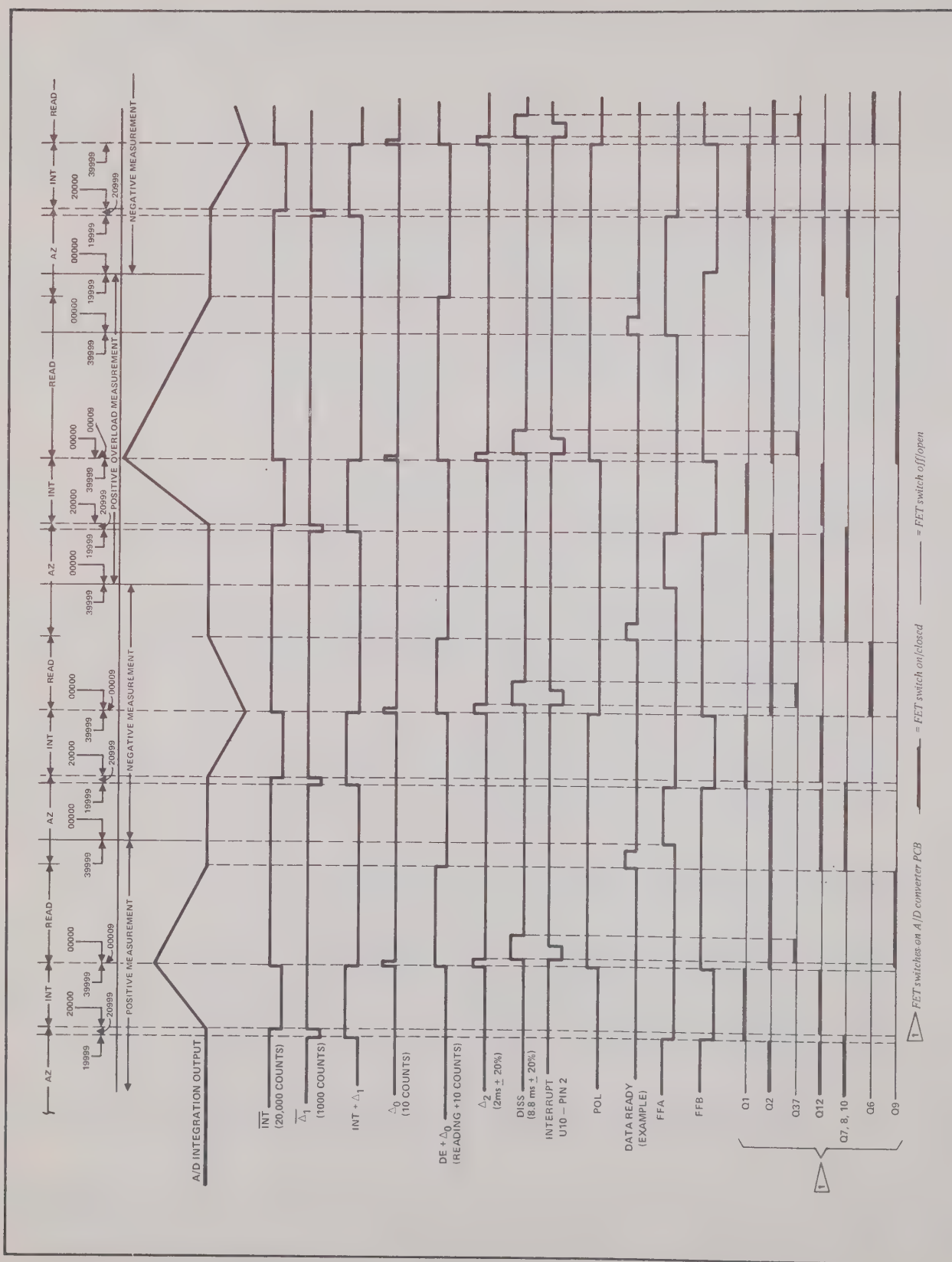


Figure 610-2. A/D Converter Timing Diagram

610-18. When the Controller detects the Data Ready status it generates a series of five Strobe In pulses which are converted on the Guard Crossing PCB into a series of five multiplexer pulses, MUX1 through MUX5. As each pulse sequentially occurs, one of the five 4-bit counter characters is solicited, transferred across the guard crossing, and placed onto the Controller's Data Bus. The entire five measurement digits (this includes polarity and overload indications as part of the MSD) must be transmitted across the guard before the next measurement cycle is allowed to start (i.e., the reference clock is inhibited until MUX5 goes low to indicate that the last digit of measurement data has been solicited).

610-19. Channel select data for measurement purposes is updated once during each a/d conversion (measurement) cycle so that new analog data can be presented to the a/d converter. Updating occurs in response to an interrupt status signal generated by the Guard Crossing PCB. The interrupt causes the Controller to specify the next programmed measurement channel and its associated function data to the Guard Crossing PCB. Data is received as a series of four 4-bit characters which are serially transferred across the guard to the A/D Converter PCB. A unique strobe pulse (S1 through S4) accompanies each character and causes it to be entered into a four bit register. The first character is entered into a range and function register by strobe pulse S1. The second, third and fourth characters are similarly entered into a series of three channel select registers by strobe pulses S2, S3 and S4, respectively.

610-20. Range and function data for the next measurement cycle are derived from the first stored character. Its two low-order bits D0 and D1 are decoded to provide the range command (4V, 400 mV, 80 mV, 40 mV) for the Range Amplifier on the a/d converter pcb. Similarly, the 40V range, open-thermocouple detect and reference-junction measure commands are decoded from the two high-order bits, D2 and D3.

610-21. Channel select commands (units, tens and hundreds) are taken directly from the output of the three channel select registers. Tens data is decoded to provide the individual block select commands for the first 60 (0-59) channels in the data logger, while units data activates the appropriate channel relay (0-9) in the selected scanner block-channel commands above 59 (60 through 999) are available at a rear-panel connector on the a/d converter pcb for use in selecting channels maintained in an external scanner chassis (2201A, 2202A and/or 2203A).

610-22. Analog Circuit

609-23. The analog portion of the dual-slope a/d converter is contained entirely on the High Performance A/D Converter PCB Assembly. It consists of an input

filter, a range amplifier, a reference supply, an integrator buffer, a comparator and a series of FET switches. Digital control signals from the Guard Crossing PCB control the operation of the FET switches and, therefore, the overall operation of the analog circuit. Figure 610-2 relates the operation of each individual FET switch to the digitally controlled measurement cycle.

610-24. Operation of any given measurement cycle can be logically divided into three measurement periods; auto zero, integrate, and read. Auto zero is used to measure and eliminate any in circuit errors which might influence the end reading. Integrate allows the input signal is sampled (integrated) for a known time period. During the read period two separate functions are performed. The next analog input is applied to the input filter for settling purposes, and the previously sampled (integrate) input voltage is compared (integrated) against a reference voltage. The time required to complete the read period is then translated, by the dual-slope control logic, into a digital equivalent of the analog input voltage.

610-25. The auto zero period begins at the end of the read period, as indicated by the leading edge of the Data Ready pulse. At that time FET switches Q1, Q37, Q6 and Q9 are open and Q2, Q7, Q8, Q10 and Q12 are closed. Switch Q1 isolates the input of the range amplifier from the analog level present at the input filter. Switches Q2 and Q8 provide a zero volt reference levels for charging a series of reference capacitors C6, C7 and C8. Capacitor C6 charges through Q8 and Q12 to a value which is equal to the offset voltage error inherent in the Range Amplifier. Similarly, capacitor C8 is charged through switch Q10 to a value which is equal to the loop offset voltage of the integrator buffer, integrator and comparator combination. Finally, capacitor C7 is charged to the +2V reference level through switches Q7 and Q8. The charges on these capacitors will be retained throughout the remainder of the measurement cycle for use in eliminating offset errors (C6 and C8), and providing the choice of selectable reference polarity (C7) which is compatible with the analog input signal.

610-26. Termination of the auto zero period occurs in two steps. First switches Q2 and Q12 are opened and switch Q1 is closed. This isolates the range amplifier output from the rest of the circuit and allows it to respond to the input voltage applied through switch Q1. Second, switches Q7, Q8 and Q10 are opened and switch Q12 is closed. This connects the output of the range amplifier to the integrator buffer. At this time the auto zero period is ended and the integrate period begins.

610-27. During the integrate period the integrator buffer presents the integrator with an offset corrected dc

input voltage which is equivalent to the analog input voltage level. This signal is then integrated for a fixed time which is equal to 20,000 read-clock pulses, as determined by the digital counters on the Guard Crossing PCB. When the time period is satisfied the integrate period is ended and the read period is started.

610-28. At the start of the read period switches Q1 and Q12 are opened, and Q2 and either Q6 or Q9 are closed. Switches Q1, Q2 and Q12 electrically remove the range amplifier and, therefore, the analog input signal from the input of the integrator buffer. If the input signal was positive, switch Q9 is closed and a -2 volt reference is applied to the integrator buffer via the previously charged reference capacitor C7. However, if the original analog input signal was negative, switch Q6 is closed causing the +2 volt reference to be applied directly to the input of the integrator buffer. In either event, integrator capacitor C9 begins to discharge at a fixed linear rate, and the counter string on the Guard Crossing PCB begins to count and accumulate the reference clock output. The discharge continues until the capacitor reaches a zero-charge level as determined by the previous auto-zero period. When that level is detected by the comparator, a compare (CM) transition is generated to terminate the read period. This stops the counter on the Guard Crossing PCB and returns the analog circuitry to the auto-zero period. (The next measurement cycle starts after data is transferred across the guard to the Controller.)

610-29. Since the range amplifier and the input filter are isolated from the rest of the analog circuit at the beginning of the read period, both digital range data and the analog input signal for the next measurement channel are entered at that time. This allows both the input filter and the range amplifier to settle before the next measurement cycle begins.

610-30. The input filter is a single pole RC filter designed to suppress noise which accompanies the input signal. On all ranges, except 40V, resistor R5 acts as the primary resistive component. The capacitive component, however, varies as a function of both measurement speed (fast/slow) and selected range. On the 40V range, resistor R5 is switched out of the input circuit by relay, K1, and is replaced by a 100:1 divider. On the 40 mV and 80 mV ranges separate capacitors as well as active clamp circuitry (U25) are switched into the circuit. Table 610-2 defines each of the input filter capacitors, as well as, which capacitor(s) is (are) selected for any given combination of range and measurement speed.

610-6

Table 610-2. Input Filter Capacitors

Filter Capacitor	Value μ F	Applicable Range and Speed (Fast or Slow)				
		40V	4V	400 mV	80 mV	40 mV
C1	0.033	F&S	F&S	F&S	—	—
C14	0.033	—	F&S	F&S	—	—
C2	0.22	—	S	S	—	—
C15	0.22	S	S	S	—	—
C20	0.068	—	—	—	F&S	F&S
C21	0.39	—	—	—	S	S

610-31. MAINTENANCE

610-32. Access/Disassembly

610-33. The A/D Converter is accessed by removing the top dust cover, and the inner guard cover from the data logger. The position of the A/D Converter in the data logger is shown in Figure 610-3. Access to the calibration adjustments does not require the removal of the guard cover. The test points referred to in the Calibration procedure are accessible through the rear panel.

CAUTION

Handle the a/d converter pcb by its edges to avoid contaminating it with oil from the hands. The use of gloves is recommended when handling the pcb.

610-34. To remove the A/D Converter from the data logger, remove the inner guard cover and disconnect the rear panel scanner chassis cable connector from the A/D Converter (this connector is present only if the data logger is equipped with the Scanner Chassis, Model 2201A, 2202A or 2203A). Pull the A/D Converter PCB straight up and out through the top of the data logger.

610-35. Fast/Slow Switch Setting

610-36. The free-run measurement speed of the a/d converter (i.e., no interruptions for recording data) is switch selectable at either 3 or 15 readings per second. Selection is accomplished by manually positioning a fast/slow switch which is located on the top-edge of the High Performance A/D Converter PCB Assembly. Figure 610-3 defines the switch location as well as the fast/slow switch positions.

610-37. System Self-Check

610-38. Two output voltages (+0.02 and +2.0V dc) are available at the rear of the data logger when the High Performance A/D Converter is installed. These voltages

NOTES:

1. TP9 IS LOCATED IN THE AREA OF TP4, 5, AND 6, AND IS IDENTIFIED ON THE PCB.
2. TP5, 6 AND 7 ARE PROVIDED FOR CONVENIENCE IN TROUBLESHOOTING AND ARE NOT USED IN THE CALIBRATION PROCEDURE.
3. SHADED ADJUSTMENTS ARE LOCATED BELOW THE TOP EDGE OF THE PCB.

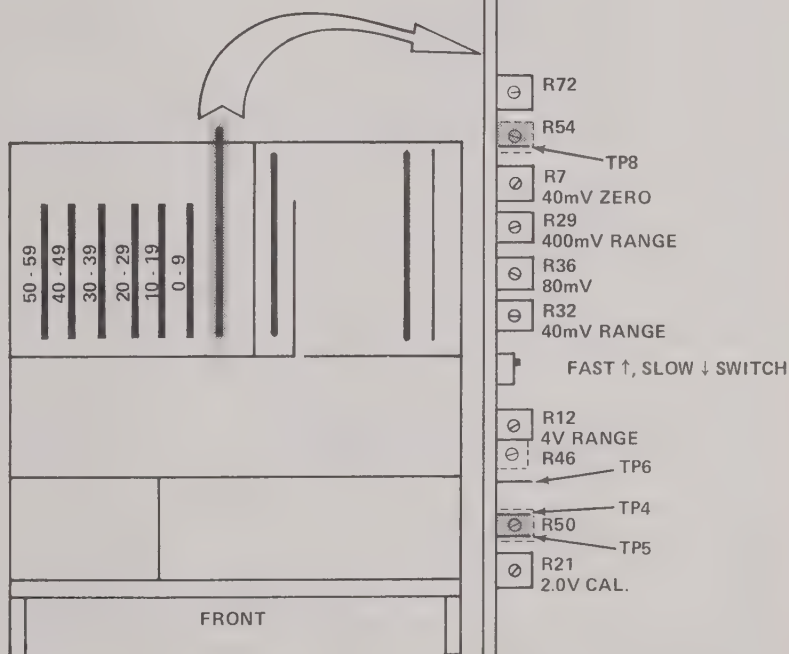


Figure 610-3. High Performance A/D Converter Test Point and Adjustment Locations

can be temporarily attached to a suspect channel to check its operation, or permanently connected to dedicated channels to establish a system self-check feature. The location of the test voltage output connectors (TP1, TP2 and TP3) is shown in Figure 610-3.

610-39. Calibration

610-40. The High Performance A/D Converter should be calibrated when the data logger is calibrated or after major repairs have been made to the pcb. A DC calibrator and a DVM are required for calibration. The recommended instruments are listed in Section 4, Table 4-1. The calibration adjustments and test points are all located on the A/D Converter PCB, and are shown in Figure 610-3. Use the following procedure to calibrate the High Performance A/D Converter:

CAUTION

Turn power off before removing or installing pcb's.

- a. De-energize the data logger and press the STOP/RESET switch in the SCAN CONTROL group.
- b. Install a Low Level Scanner (Option —06) in scanner slot 0 of the data logger.
- c. Set the output of the DC calibrator to 0V, and, using a Solder Pin Connector (Option —07), connect the output of the DC calibrator to Channel 0 of the scanner in slot 0.
- d. Energize the data logger and program it to perform the following scan sequence:
 1. Monitor Channel 00.
 2. Function = 40 mV.

- e. Set the Fast/Slow switch on the A/D Converter to Slow. See Figure 610-3.
- f. Press the MONITOR switch and adjust the 40 mV ZERO pot (R7) for a zero indication i.e., the display alternates between a + and - polarity indication. Ignore the digital display.

NOTE

Under normal conditions steps g through o may be omitted from the calibration procedure. However, if the A/D Converter has been repaired prior to calibration, component parts have been replaced, or potentiometers R46, R50 or R55 have been inadvertently adjusted the steps must be executed.

- g. Remove the inner guard cover and mount the A/D Converter on extender cables.
- h. Connect a DVM between TP4 (common) and TP8. Adjust R54 for a reading of 0 ± 20 mV dc.
- i. Program the data logger for the 4V function and set the DC Calibrator for a +1 mV output.
- j. Adjust R50 for a data logger display of 0.0010V.
- k. Reverse the polarity of the DC Calibrator output. The display should read -0.0010V.
- l. Set the Fast/Slow switch to Fast and adjust R46 for a display of -0.0010V.
- m. Reverse the polarity of the DC Calibrator output. The display should read 0.0010V.
- n. Set the Fast/Slow switch to Slow.
- o. Set the output of the DC Calibrator to 0V.
- p. Connect the DVM between TP4 and TP9.
- q. Adjust R72 for a DVM reading of 0 ± 5 mV dc.
- r. Remove the extender cables, mount the A/D Converter in its slot, and install the inner guard cover. Allow the A/D Converter 30 minutes to stabilize its temperature before proceeding.
- s. Set the output of the DC Calibrator to -3.0000 volts and adjust R12 for a display of 3.0000V.
- t. Reverse the polarity of the DC Calibrator output. The reading should be -3.0000 ± 0.0002 V.
- u. Set the DC Calibrator output to +300 mV.
- v. Program the data logger function to 400 mV and adjust R29 for a display of 300.00 mV.
- w. Set the DC Calibrator output to +60 mV.
- x. Program the data logger function to 80 mV and adjust R36 for a display of 30000.

NOTE

The 80 mV function is programmed using the HI LIMIT switch on the 2240A, and FUNCTION switch position 9 on the 2200A.

- y. Set the DC Calibrator output to +30 mV.
- z. Program the data logger function to 40 mV and adjust R32 for a reading of +30.000 mV.
- aa. Program the data logger to the 40V function and set the DC Calibrator output to 0 volts. The display should read 0.000V.
- ab. Set the DC Calibrator output to +30V and adjust R4 for a display of 30.000V.
- ac. Connect the DVM between TP1 (common) and TP3 on the A/D Converter PCB. Adjust R21 for a DVM display of +2.0000V dc.
- ad. Connect a DVM between TP1 and TP2. Adjust R44 for a DVM display of +20.000 mV.
- ae. Set the DC Calibrator to 0 volts and program the data logger function to 40 mV. The data logger display should read 0.000V.
- af. Set the Fast/Slow switch to the speed at which the A/D Converter is to operate and adjust R7 for a data logger display of 0.000V.

610-41. LIST OF REPLACEABLE PARTS

610-42. A list of replaceable parts for the High Performance A/D Converter PCB Assembly is given in Table 610-3. Refer to Section 5 of this manual for ordering information.

**CAUTION**

Indicated devices are subject to damage by static discharge.

Table 610-3. High Performance A/D Converter PCB Assembly, Option —10

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
—10	HIGH PERFORMANCE A/D CONVERTER PCB ASSEMBLY (2200A-4028T) Figure 610-4						
C1, C14	Cap, poly propolyene, $0.033 \mu\text{F} \pm 10\%$, 50V	424218	84411	Type JF86	2		
C2, C15	Cap, poly propolyene, $0.22 \mu\text{F} \pm 10\%$, 50V	423210	84411	Type JF86	2		
C3, C17	Cap, mica, $4 \text{ pF} \pm 0.5 \text{ pF}$, 500V	190397	72136	DM15C040K	2		
C4, C5 C18, C19	Cap, cer, $500 \text{ pF} \pm 10\%$, 1 kV	105692	71590	2DDH60N501K	4		
C6, C7, C8	Cap, pol car, $2.2 \mu\text{F} \pm 10\%$, 100V	306522	73445	C280MCH/A2- M2	3		
C9	Cap, poly propolyene, $0.47 \mu\text{F} \pm 10\%$, 50V	363085	84411	Type JF86	1		
C10	Cap, cer, $0.0027 \mu\text{F}$ GMV, 600V	106211	56289	5GA-D33	1		
C11, C12, C13	Cap, Ta $10 \mu\text{F} \pm 20\%$, 20V	330662	56289	196D106X- 0020XA1	3		
C16	Cap, mica, $33 \text{ pF} \pm 5\%$, 500V	160317	72136	DM15E330J	1		
C20	Cap, poly propolyene, $0.068 \mu\text{F} \pm 10\%$, 50V	424226	84411	Type JF86	1		
C21	Cap, poly propolyene, $0.039 \mu\text{F} \pm 10\%$, 50V	424234	84411	Type JF86	1		
C22	Cap, cer, $0.005 \mu\text{F} \pm 20\%$, 50V	255471	51642	200-050-601- 502M	1		
CR2, CR7, CR8, CR9, CR11, CR12	Diode, Si	203323	07910	1N4448	6	2	
J15	Connector, rear panel, 36 pin	414409	00779	552241-1	1		
J29	Socket, IC, 14-pin DIP	387316	71785	135-59-02-059	1		
J1	Relay	404061	71707	CR-3201-5-710	1		
Q1 thru Q5, Q8, Q9, Q10, Q12, Q16, Q17, Q18, Q20, Q21, Q22, Q30, Q32 thru Q37	Xstr, J-FET, N-channel	357905	34677	F2690	22	5	

Table 610-3. High Performance A/D Converter PCB Assembly, Option —10 (Continued)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Q6, Q7, Q11, Q15, Q31	Xstr, J-FET, N-channel	376475	34677	F2726	5	1	
Q13	Xstr, FET, dual, N-channel	376087	17856	U405/DN1422	1	1	
Q14	Xstr, FET, dual N-channel	379321	17856	E7024	1	1	
Q19	Xstr, Si, NPN	218396	04713	2N3904	1	1	
R1, R2	Res, network	375105	89536	375105	2	1	
R3, R61	Res, comp, $10k \pm 5\%$, $\frac{1}{4}W$	148106	01121	CB1035	2		
R4, R12, R32	Res, var, $500 \pm 10\%$, $\frac{1}{2}W$	291120	89536	291120	3	1	
R5	Res, comp, $39k \pm 5\%$, $2W$	424721	01121	HB3935	1		
R7, R21, R46	Res, comp, $50k \pm 10\%$, $\frac{1}{2}W$	288290	89536	288290	3		
R8	Res, mf $2k \pm 0.1\%$, $1/8W$	340174	91637	MFF1-82001B	1		
R9, R10, R15, R19, R45, R57	Res, comp, $22k \pm 5\%$, $\frac{1}{4}W$	148130	01121	CB2235	6		
R11, R13,	Reference voltage set (matched components)	377283	89536	377283	1	1	
R14	Res, ww, $40k \pm 0.2\%$, $\frac{1}{2}W$	112037	89536	112037	1	1	
R16	Res, mf, $23.7k \pm 1\%$, $1/8W$	188367	91637	MFF1-82372F	1		
R17, R18	Res, mf, $15k \pm 1\%$, $1/8W$	285296	91637	MFF1-81502F	2		
R20	Res, mf, $130k \pm 1\%$, $1/8W$	221648	91637	MFF1-81303F	1		
R22	Res, mf, $1M \pm 1\%$, $1/8W$	268797	91637	MFF1-81004F	1		
R23, R55, R70, R73, R74, R76 thru R79, R84	Res, comp, $100k \pm 5\%$, $\frac{1}{4}W$	148189	01121	CB1045	10		
R24	Res, mf, $4.02k \pm 1\%$, $1/8W$	235325	91637	MFF1-84021F	1		
R25, R53	Res, comp, $1.5k \pm 5\%$, $\frac{1}{4}W$	148031	01121	CB1525	2		
R27	Res, comp, $3.3M \pm 5\%$, $\frac{1}{4}W$	208389	01121	CB3355	1		
R28	Res, ww, $22.5k \pm 0.1\%$, $\frac{1}{2}W$	112045	89536	112045	1	1	
R29	Res, var, cer, $5k \pm 10\%$, $\frac{1}{2}W$	288282	89536	288282	1	1	

Table 610-3. High Performance A/D Converter PCB Assembly, Option —10 (Continued)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R30	Res, mf, 806k $\pm$ 1%, 1/8W	217976	91637	MFF1-88063F	1		
R31	Res, ww, 2k $\pm$ 0.1%, 1/2W	171843	89536	171843	1	1	
R33, R34	Res, mf, 100k $\pm$ 1%, 1/8W	248807	91637	MFF1-81003F	2		
R35, R40	Res, ww, 250 $\pm$ 0.05%, 1/2W	182220	89536	182220	1	1	
R36	Res, var, cer, 1k $\pm$ 10%, 1/2W	285155	89536	285155	1	1	
R37	Res, ww, matched	178780	89536	178780	1	1	
R38, R47	Res, mf, 75k $\pm$ 1%, 1/8W	291443	91637	MFF1-87502	2		
R39	Res, ww, 1.022k $\pm$ 0.05%, 1/4W	288654	89536	288654	1	1	
R41	Res, comp, 2.2k $\pm$ 5%, 1/4W	148049	01121	CB2225	1		
R42, R43	Res, mf, 6.81k $\pm$ 1%, 1/8W	268417	91637	MFF1-86811F	2		
R44, R72	Res, var, cer, 20k $\pm$ 10%, 1/2W	291609	89536	291609	2	1	
R48	Res, mf, 56.2k $\pm$ 1%, 1/8W	271346	91637	MFF1-85622F	1		
R49	Res, mf, 14.3k $\pm$ 1%, 1/8W	291617	91637	MFF1-81432F	1		
R50, R54	Res, var, cer, 200 $\pm$ 10%, 1/2W	285148	89536	285148	2	1	
R51	Res, comp, 820k $\pm$ 5%, 1/4W	220541	01121	CB8245	1		
R52	Res, comp, 680k $\pm$ 5%, 1/4W	188433	01121	CB6845	1		
R56	Res, ww, 19.991k 1/2W	277988	89536	277988	1	1	
R60, R80	Res, comp, 47k $\pm$ 5%, 1/4W	148163	01121	CB4735	2		
R63	Res, comp, 1k $\pm$ 5%, 1/4W	148023	01121	CB1025	1		
R64	Res, comp, 470 $\pm$ 5%, 1/4W	147983	01121	CB4715	1		
R71, R75	Res, comp, 750 $\pm$ 5%, 1/4W	218024	01121	CB7515	2		
R81, R82	Res, comp, 10M $\pm$ 5%, 1/4W	194944	01121	CB1065	2		
R83	Res, comp, 100M $\pm$ 10%, 1/2W	190520	01121	EB1071	1		
S1	Switch, slide, dpdt	423129	10389	43-100-113	1	1	
U1, U2	IC, linear, op amp	404087	49956	RC4739DP	2	1	
U3	IC, linear, comparator	352195	12040	LM311N-8	1	1	
U4	IC, linear, voltage regulator	419044	49956	RC4195T	1	1	
U5	IC, linear, op amp	284760	12040	LM308	1	1	

Table 610-3. High Performance A/D Converter PCB Assembly, Option —10 (Concluded)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U6	IC, TTL, quad 2-input AND gate (selected)	412759	89536	412759	1	1	
U7, U26	IC, xstr array (selected)	413327	89536	413327	2	1	
U13	IC, TTL, dual J-K flip-flop	393157	01295	SN74LS107	1	1	
U14	IC, TTL, decoder/demultiplexer	393165	01295	SN74LS139	1	1	
U15 thru U18	IC, CMOS, 4-bit register with tri-state outputs (X)	412742	12040	MM74C173N	4	1	
U19	IC, CMOS, 8-input OR gate (X)	418798	12040	MM4048AN	1	1	
U20	IC, CMOS, 1-of-10 decoder (X)	380741	86684	CD4028AE	1	1	
U21	IC, CMOS, hex buffer inverter (X)	381830	86684	CD4050AE	1	1	
U22	IC, TTL, quad 2-input NAND gate	393033	01295	SN74LS00N	1	1	
U23, U24	Res, network, 100k	412726	89536	412726	2	1	
U25	IC, linear, opnl ampl	418566	12040	LM358N	1	1	
VR5, R11, R13	Reference voltage set (matched components)	377283	89536	377283	1	1	
VR6, VR10	Diode, zener, 5.6V	277236	07910	1N752A	2	1	
	Connector, test point, female	170480	74970	105-752	3		
	Connector, test point, male	267500	00779	861442	6		
	Hardware, connector mounting, J15	435750	00779	552561-1	1		

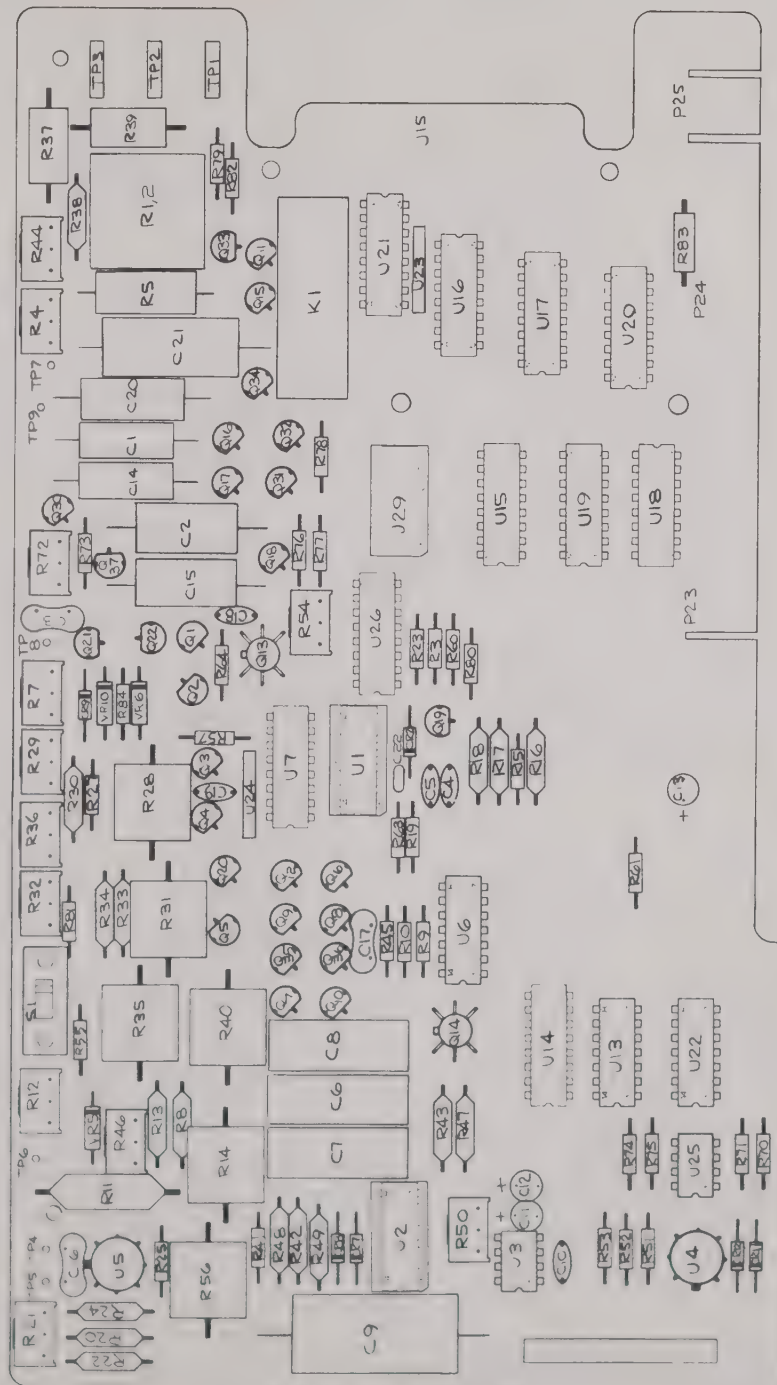
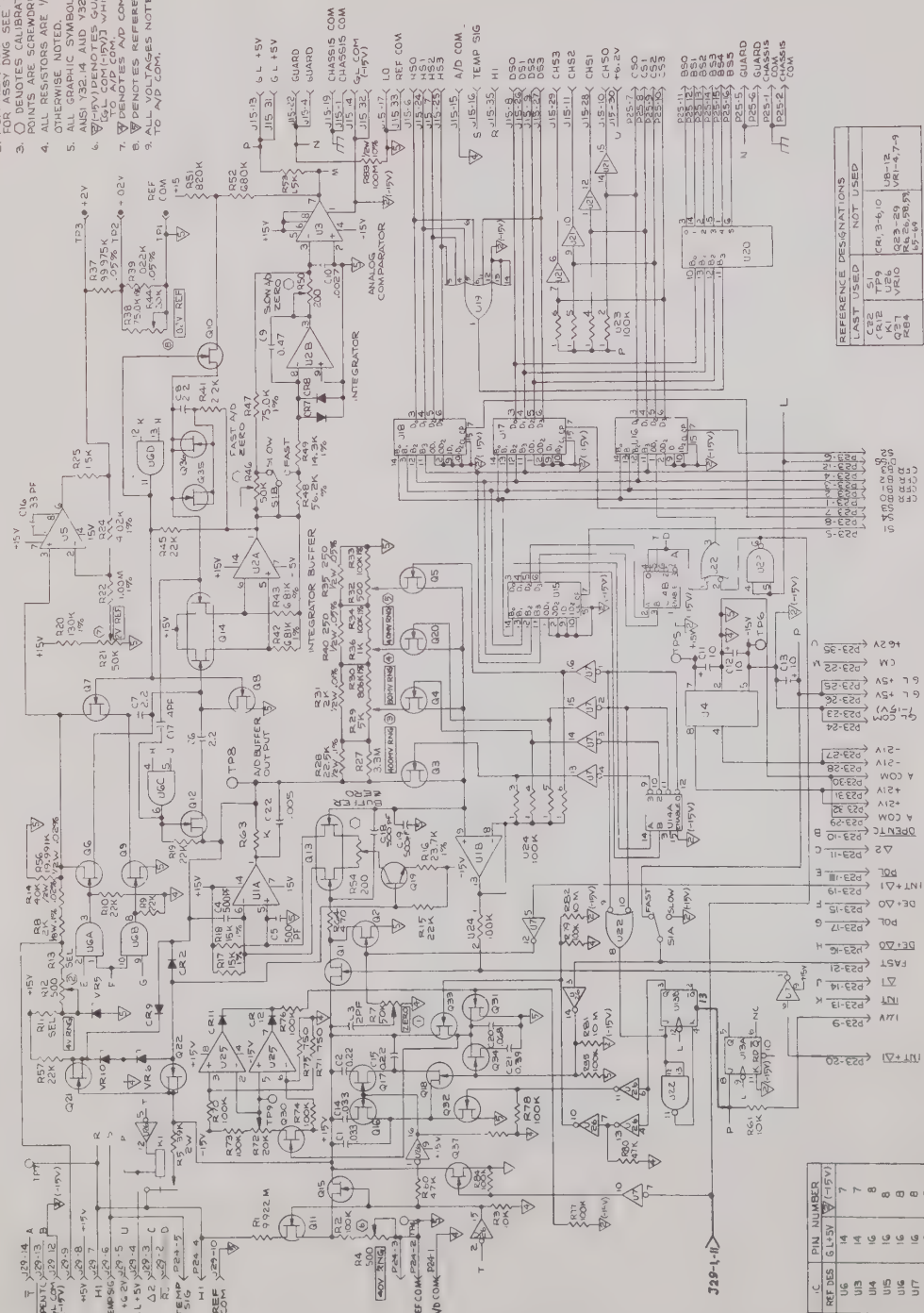


Figure 610-4. High Performance A/D Converter PCB Assembly, Option -10 (2200A-1028) (Sheet 1 of 2)

- NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS, CAPACITANCES ARE IN MICROFARADS.
 2. FOR REF. DES. DWG. SEE 2200A-162B.
 3. FOR ASSY DWG. SEE 2200A-1703.
 4. UNLESS OTHERWISE SPECIFIED, ALL POINTS ARE SCREWDRIVER ADJUST.
 5. ALL RESISTORS ARE 1/4 W, 5% UNLESS OTHERWISE NOTED.
 6. ALL GRAPHIC SYMBOLS IN ACCORDANCE WITH ANSI Y32.14 AND Y32.2.
 7. ALL LOGIC IS 74LS00 UNLESS OTHERWISE NOTED.
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REFERENCE DESIGNATIONS	LAST USED	NOT USED
U1	CR1	3-4, 10
U2	CR2	TP9
U3	CR3	29
U4	CR4	VR1-4, 7-9
U5	CR5	29
U6	CR6	29
U7	CR7	29
U8	CR8	29
U9	CR9	29
U10	CR10	29
U11	CR11	29
U12	CR12	29
U13	CR13	29
U14	CR14	29
U15	CR15	29
U16	CR16	29
U17	CR17	29
U18	CR18	29
U19	CR19	29
U20	CR20	29
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U91	CR91	29
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U93	CR93	29
U94	CR94	29
U95	CR95	29
U96	CR96	29
U97	CR97	29
U98	CR98	29
U99	CR99	29
U100	CR100	29

Figure 610-4. High Performance A/D Converter PCB Assembly, Option -10 (2200A-1028) (Sheet 2 of 2)

Option —11 Temperature and Scaling

611-1. INTRODUCTION

611-2. The Temperature and Scaling Option (—11) is a factory installed option that provides the data logger with the capability of measuring and scaling up to four types of transducer inputs to allow direct measurement readings in engineering units. Compatible transducers include thermocouples, RTD's, (resistance temperature detectors) and current transmitters.

611-3. When using thermocouple inputs, the Temperature and Scaling Option operates in conjunction with the Isothermal Connectors to provide direct temperature readouts selectable in °C or °F. Linearization and scaling programs can be chosen for a total of four thermocouple types: four group A types (J, K, T, R, S) or three group A types and one group B type (E, G, B, C, D [W3]). With the addition of the Multiple Group B PROM assembly (Option —26), all four functions can be designated from group B.

611-4. Measurement resolution using thermocouple inputs is a function of the a/d converter and the scanners used at the thermocouple inputs. A 0.1° resolution is achieved using the Low-Level Scanner and the High Performance A-D Converter. A 1.0° resolution is achieved using the General Purpose Scanner and the General Purpose A-D Converter.

611-5. Current measurements derived from one-of-three types of current transmitter connectors can be scaled by the Temperature and Scaling Option to provide readings in percent. For example, the 1 to 5 mA current transmitter input would be scaled to read 1 mA as 0% and 5 mA at 100%. If measurement units other than percent are required, the Custom Scaling Option (Option —25) must be installed.

611-6. SPECIFICATIONS

611-7. Specifications for the Temperature Measurement Converter option are contained in Section 1 of this manual.

611-8. OPERATION

611-9. Once installed in the data logger, the Temperature Measurement System requires no operator attention other than ensuring that the transducers connected at the measurement channels are compatible with the measurement functions selected for those channels. Instructions for assigning measurement functions to specific channels are contained in Section 2 of this manual.

611-10. The temperature measurement scale can be set by the user to provide a direct temperature read out in either °C or °F. A switch located on the Controller is used to select the desired scale. Information necessary to properly set the switch is given later under maintenance.

NOTE

Thermocouple temperature measurements require the use of an Isothermal Block Connector (Option —08).

NOTE

When a series of C's is displayed during a scan sequence, it indicates that the thermocouple input for the channel indicated is open circuited ($R_{source} > 7.5 \pm 2.5 \text{ k}\Omega$). See Figure 611-1.

611-11. THEORY OF OPERATION

611-12. General

611-13. The Temperature and Scaling Option operates as an extension of the a/d converter (Option —09 or —10) to provide direct-reading temperature measurements using thermocouple probes. It consists of a Temperature Measurement PCB, a linearization ROM, and a configuration PROM. The temperature Measurement PCB mounts on the a/d converter as a plug-in subassembly and provides the analog switching necessary for open thermocouple detection as well as

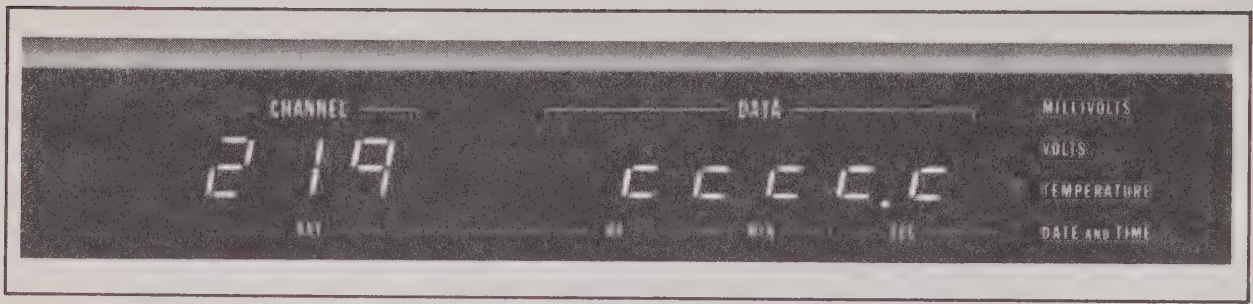


Figure 611-1. Open Thermocouple Indication for Channel 219

reference junction measurement. Both the ROM and the PROM plug into sockets provided on the Controller PCB. The linearization ROM contains the linearization program for the microprocessor and the linearization tables for thermocouple types, J, K, R, S and T. The configuration PROM relates the front panel function switches (T1, T2, T3 and T4) to the proper linearization table and a/d converter range. See Table 611-1.

611-14. When a temperature measurement is made the processor first calls for a reference junction measurement to determine the temperature of the terminal block on the measurement channel's Isothermal Block Connector (Option —08). Since this temperature is the same for all thermocouples associated with the block connector, only one measurement is required each time the block channels are scanned. Measured reference junction data is then sent to the microprocessor where it is used to derive a voltage offset which is the difference between the voltage generated at the thermocouple termination at ambient temperature and the terminal voltage which would be observed at 0°C. (The difference is due to the thermocouple effect at the terminal block where a transition is made from thermocouple wire alloys to copper.) This voltage is then added to each subsequently measured thermocouple voltage at the Isothermal Block Connector. The result is a thermocouple output relative to a terminal point temperature of 0°C. Finally the corrected thermocouple voltage is converted, via a piecewise linear approximation, (linearization ROM), into an equivalent temperature which is subsequently displayed. A resolution of 0.1° (1 or 2 μ V) can be obtained using the High Performance A/D Converter, while the General Purpose A/D Converter will provide 1° resolution (10 μ V).

611-15. Temperature Measurement PCB Assembly

611-16. The operation of the Temperature Measurement PCB can be divided into three separate functions; open thermocouple detector, reference voltage buffer, and reference junction measurement. Refer to the

schematic diagram, Figure 611-3, to supplement to the following descriptions.

611-17. Open thermocouple detection is enabled when the measurement function has been programmed for a thermocouple temperature measurement (T1, T2, T3 or T4). The enabling program data bit is stored in the function register on the a/d converter pcb and is delivered to the Temperature Measurement PCB as a low signal via the $\overline{T}$ (temperature) input. At the end of the a/d converter's integration period (during $\Delta 2$) relay K2 is energized and R-S flip-flop (U1B and U1C) is preset. The closed contacts of K2 allows the flip-flop to observe the condition of the input thermocouple, and reset if a normally low impedance is encountered ($<7.5 \pm 2.5$ k Ω). Otherwise the flip-flop will remain in the preset condition and generate an open-thermocouple indication (open TC low). At the beginning of the read portion of the measurement cycle the $\Delta 2$ pulse returns low allowing relay K2 to open. This allows the flip-flop to remain latched in its current position until changed during subsequent temperature measurement cycles.

611-18. The reference voltage used to power the reference junction circuitry on the Isothermal Block Connectors (Option —08) is derived from the 6.2V reference on the a/d converter pcb. A unity gain amplifier on the Temperature Measurement PCB buffers the reference voltage and drives the 6.2V bus which supplies operating power to the Isothermal Connectors housed in both the data logger and the extender chassis.

611-19. When the reference junction is to be measured, input $\overline{RJ}$ (from the function register on the a/d converter) is driven low causing the dpst contacts of relay K1 to close. As a result the output of the reference voltage amplifier is connected to the 6.2V reference bus. A return signal in the form of reference junction temperature from the enabled Isothermal Block Connector (Option —08) is presented to the a/d converter for measurement purposes through the other pair of relay contacts.

Table 611-1. Definition of Configuration PROM Address Codes and Output Codes

ADDRESS FUNCTION	PROM Location	OUTPUT DATA				OUTPUT CODES									
		B ₃	B ₂	B ₁	B ₀										
Indicates that Option -11 is installed	00	0	0	0	0	0000 denotes that function T1, T2, T3, T4 are in system									
Not used	01 02 03					Not used									
Determine display annotation codes and decimal point location codes.	04	T1 Decimal Point				Display Code				Decimal Point					
	05	T1 Display Code				B ₃	B ₂	B ₁	B ₀	B ₃	B ₂	B ₁	B ₀		
	06	T2 Decimal Point				1	0	1	0	Temperature	0	0	0	1	
	07	T2 Display Code				1	0	1	1	mV	0	0	1	0	
	08	T3 Decimal Point				1	1	0	0	V	0	0	1	1	
	09	T3 Display Code				1	1	0	1	Time	0	1	0	0	
	0A	T4 Decimal Point				1	1	1	1	(Blank)	/	/	/	/	
	0B	T4 Display Code													
Determine the A/D range codes.	0C	T1 A/D Range													
	0D	T2 A/D Range				Reference Junction	B ₃	B ₂	B ₁	B ₀	B ₃	B ₂	B ₁	B ₀	
	0E	T3 A/D Range				40 mV Temp.	0	0	1	1	40 mV	1	0	0	0
	0F	T4 A/D Range				80 mV Temp.	1	1	0	0	80 mV	1	0	0	1
Determine the transducer personality codes.	10	T1 Personality				B3 = 1⇒ linearize A/D reading B3 = 0⇒ no linearization									
	11	T2 Personality				B2 = 1⇒ round up least significant digit and blank it for display if A/D is 10 μV type (e.g., 1° temperature)									
	12	T3 Personality				B1 = 0⇒ allow linearization program to make °C to °F conversion based on °C/°F select switch, B1 = 1⇒ force °C linearization									
	13	T4 Personality				B0 = 0⇒ allow A/D type flag to linearization B0 = 1⇒ force 1μV									
Determine the printer annotation codes.	14	T1 R. Annunciator				B ₃	B ₂	B ₁	B ₀	Left Annunciator		Right Annunciator			
	15	T1 L. Annunciator				0	0	0	0	DC		V			
	16	T2 R. Annunciator				0	0	0	1	AC		Ω			
	17	T2 L. Annunciator				0	0	1	0	k		lb			
	18	T3 R. Annunciator				0	0	1	1	M		Hz			
	19	T3 L. Annunciator				0	1	0	0	m		s			
	1A	T4 R. Annunciator				0	1	1	0	°C		%			
	1B	T4 L. Annunciator				0	1	1	1	°F		si			
						1	0	0	0	dB		F			
						1	0	0	1	μ		W			
						1	0	1	0	G		A			
						1	0	1	1	(Blank)		(Blank)			
					1	1	0	0	kg		mA				
					1	1	0	1	(Blank)		(Blank)				
					1	1	1	0	(Blank)		(Blank)				
					1	1	1	1	(Blank)		(Blank)				
Determine where the linearization coefficient data base is located.	1C	T1 Coef. Location				For -11 Usage									
	1D	T2 Coef. Location				B ₃	B ₂	B ₁	B ₀						
	1E	T3 Coef. Location				0	0	0	0	Controller U5 ROM Page 3					
						0	0	1	0	Controller U5 ROM Page 4					
	1F	T4 Coef. Location				0	1	0	0	Controller U5 ROM Page 5					
					0	1	1	0	Controller U5 ROM Page 6						
					1	0	0	0	Controller U5 ROM Page 7						
					1	0	1	0	Controller U11 PROM Socket						

611-20. MAINTENANCE

611-21. Access

611-22. The Temperature and Scaling Option comprises one pcb assembly and two IC's. These components are installed on two separate locations in the data logger and can be easily accessed for maintenance purposes. Figure 611-2 defines the individual component locations of both the Controller and a/d converter PCB's. Access to these pcb's is achieved by removing the top cover and the two inner-guard covers from the data logger.

611-23. Temperature Scale Switch Settings

611-24. Temperature measurements can be displayed in terms of either °C or °F by properly setting a switch on the Controller PCB Assembly. The switch location is shown in Figure 611-2 (Celsius/Fahrenheit switch, #3). Setting the switch to ON selects the Fahrenheit scale. Conversely, OFF selects the Celsius scale.

611-25. Calibration

611-26. The Temperature Scaling Option does not require calibration. However, its accuracy is dependent upon the calibration of the A/D Converter (Option —09 or —10) and the reference junction on the Isothermal Block Connector (Option —08).

611-27. LIST OF REPLACEABLE PARTS

611-28. A list of replaceable parts for the Temperature and Scaling Option is given in Table 611-2. Refer to Section 5 of this manual for ordering information.



CAUTION

Indicated devices are subject to damage by static discharge.

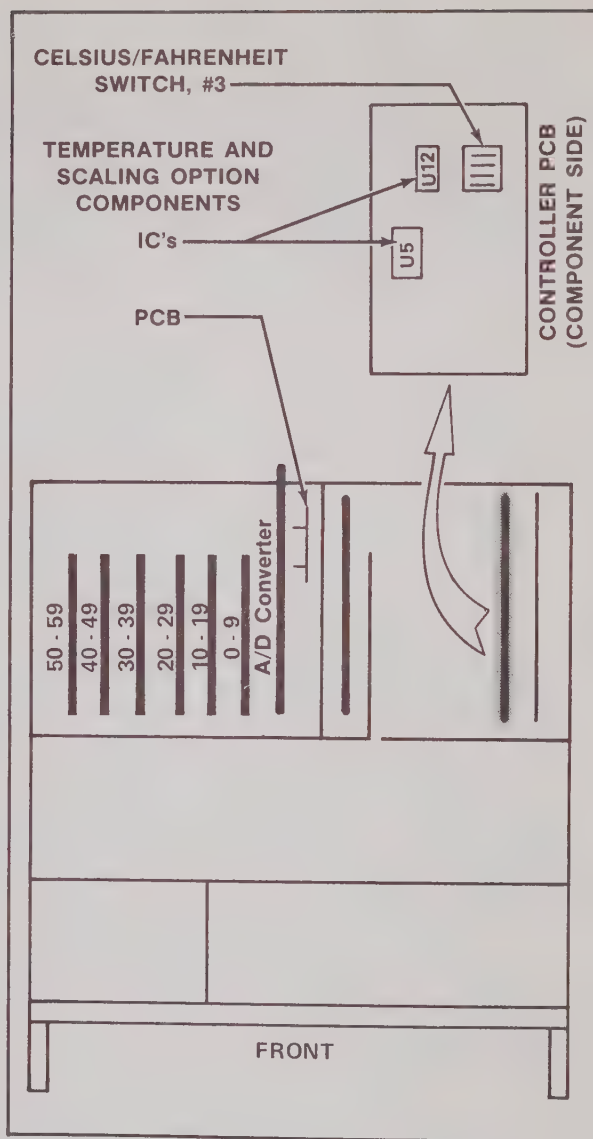


Figure 611-2. Temperature and Scaling Option, Component and Scale-Switch Locations

Table 611-2. Temperature and Scaling Option, —11

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
-11	TEMPERATURE AND SCALING OPTION, -11						
	Temperature and Scaling Option PCB Assembly	409565	89536	409565	1		
U5	IC, CMOS, ROM, linearization group A(J, K, T, R, S)  	418517	89536	418517	1		
U11	IC, CMOS, PROM, linearization, group B(E, B, C, G, D, current transmitter, RTD392, RTD385). Installed only when group B scale is required.  	432757	89536	432757	1		
U12	IC, CMOS, PROM, configuration  	432666	89536	432666	1		
	 These ICs are programmed and labeled in accordance with customer requirements at the time of purchase. If replacement is necessary, the special markings from the original part-label must accompany the order.						
	TEMPERATURE AND SCALING OPTION PCB ASSEMBLY (2200A-4021) Figure 611-3	409565	89536	409565	REF		
C1	Cap, mica, 33 pF $\pm 5\%$, 500V	160317	72136	DM15E033J	1		
C2	Cap, plstc, 0.47 μ F, $\pm 10\%$, 50V	271858	06001	75F1R5A474	1		
CR1, CR2, CR3	Diode, Si, switch	203323	07910	1N4448	3	1	
K1	Reed Relay						
	Coil	272070	71707	U-D-6-P	1		
	Reed Switch	414300	95348	MR5830-7	2		
K2	Reed Relay						
	Coil	269019	71707	U-6-P	1		
	Reed Switch	414300	95348	MR5830-7	1		
P29	Connector, post	267633	00779	86144-1	14		
Q1, Q2, Q3	Xstr, Si, PNP	195974	04713	2N3906	3	1	
Q4	Xstr, Si, NPN	218396	04713	2N3904	1	1	
R1, R2, R3, R5	Res, comp, 4.7k $\pm 5\%$, $\frac{1}{4}$ W	148072	01121	CB4725	4		

Table 611-2. Temperature and Scaling Option, —11 (Continued)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R4	Res, comp, 2.2k $\pm$ 5%, 1/4W	148049	01121	CB2225	1		
U1	IC, TTL, quad 2-input NAND gate	393033	04713	MC74LS00L	1	1	
U2	IC, linear, op amp	363515	12040	LM301AN	1	1	

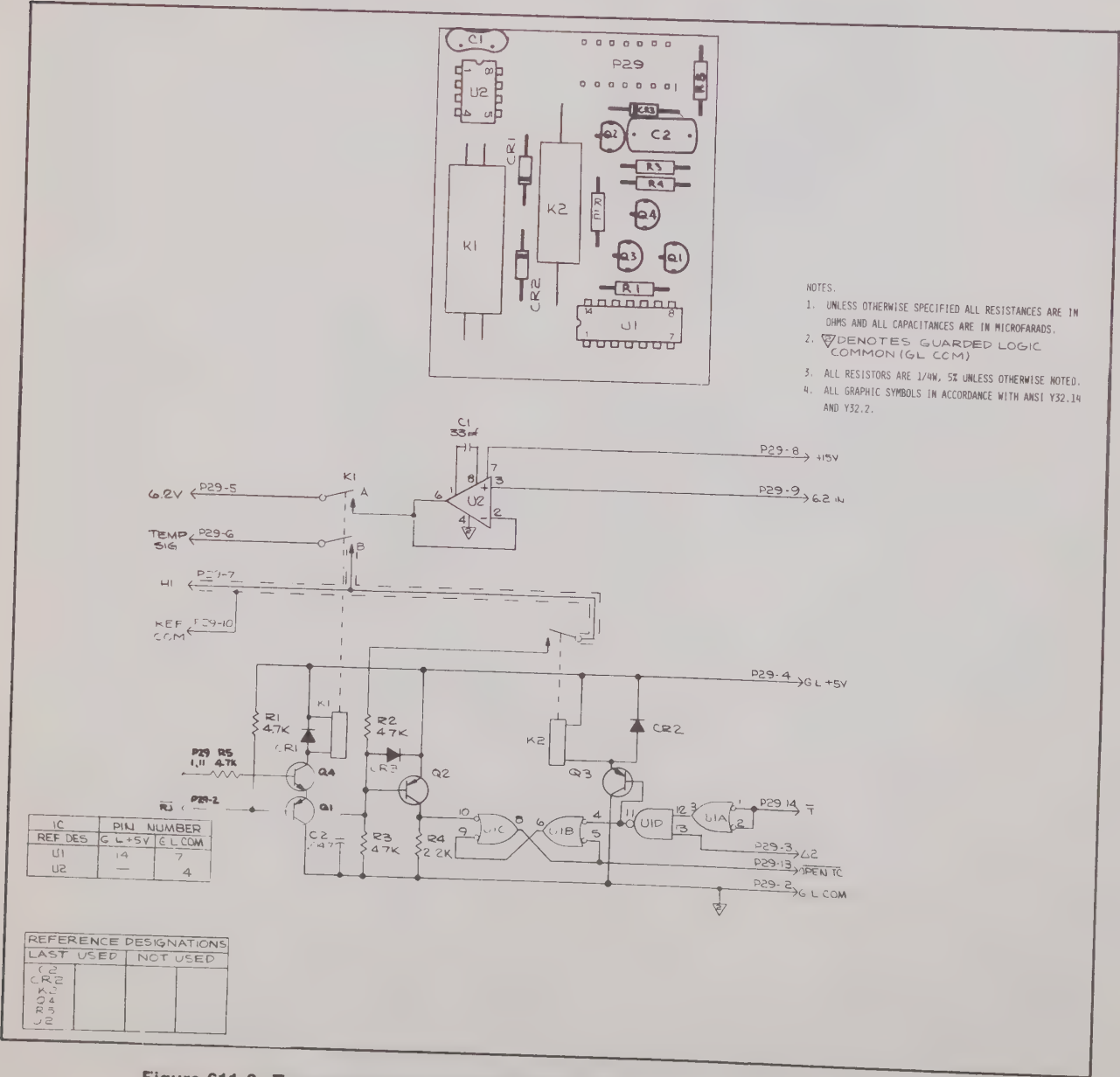


Figure 611-3. Temperature and Scaling Option PCB Assembly, Option —11 (2200-1021)

—12 Series Teleprinter and RS-232-C Interface Options

612-1. SCOPE

612-2. The —12 Series Options include Options —12B through —12P and most are described in Section I of the data logger manual. Each option in the series is compatible with a commercially available teleprinter or RS-232-C compatible recorder. The information contained herein deals with the basic Digital Output PCB used to interface these recorders

612-3. INTRODUCTION

612-4. The Digital Output PCB is designed to transfer bit serial/character-serial data from the data logger to an external recording peripheral. This includes: Time-of-Year (2240B), Fixed Data (2240B), Scan Counter (2200A), Digital Input Data (Option —16), and measurement data. The appropriate carriage-return and line-feed characters are also generated. Provisions are included for initiating a scan sequence using a remote start input.

612-5. A unique interface cable and a series of 24 switches on the pcb are used to tailor the digital output to the recorder. The cable is included as part of the option. The switches are set by the user to define recorder baud rate and data format.

612-6. The pcb used with the —12 Series options is capable of operating as either an RS-232-C or a 20 mA current loop interface. For current loop operation a relay on the pcb opens and closes the loop for character transmission. The 20 mA current source must be resident in the Teletypewriter.

612-7. Table 612-1 defines the configuration of each available option in the -12 series, as well as, its intended interface type; current loop or RS-232-C. Order by option number and description.

612-3. SPECIFICATIONS

612-9. Specifications for the —12 series of options are given in Table 612-2.

Table 612-1. Configuration of —12 Series Options

OPTION NO.	DESCRIPTION	OPTION COMPONENTS (INDICATED BY •)				INTERFACE TYPE	
		PCB	CABLE	RECORDER	HARD-WARE	20 mA	RS-232C
—12B	ASR-33 Interface	•	•			x	
—12C	TI733 KSR/RO Interface	•	•				x
—12L	RS-232C General Purpose Terminal Interface	•	•				x
—12M	RS-232C General Purpose Modem Interface	•	•				x
—12N	Tektronix 4923 and Interface	•	•	•			x
—12P	Tektronix 4923 Cartridge Recorder			•			x

Table 612-2. —12 Series Option specifications

Compatibility	Specify at time of purchase, using alphabetic suffix as shown in Table 617-1
Output Format	Bit-serial
Output Levels	20 mA dc current loop (—12B) and EIA Standard RS-232C (—12C, —12E, —12H, —12L, —12M, —12N)
Output Code	ASCII 7-level (no parity bit)
Measurements per Line	1 through 16, switch selectable
Word Format	Unwanted word blocks may be deleted by switches on pcb. Word order cannot be changed
Record Format	CR, LF (Carriage Return, Line Feed) Time-of-Day (days, hrs., min., s) CR, LF CR, LF (not in —12C), fixed Data, CR, LF Digital Inputs CR, LF (—16 Option) Channel, limit, sign, data , range, function, CR, LF
Baud Rate	
RS-232-C	110, 300, 1200, 2400, 4800 (Switch selectable)
20 mA Current Loop	110
—12C	110, 300

612-10. INSTALLATION

612-11. Digital Output PCB

612-12. Up to three Digital Output PCB's can be mounted in the data loggers I/O slots, as shown in Figure 612-1. Install each —12 Series pcb as follows:

WARNING

REMOVE LINE POWER AND ALL OTHER HIGH VOLTAGE INPUTS TO THE DATA LOGGER BEFORE STARTING THIS PROCEDURE.

- a. Set the data logger POWER switch to OFF.
- b. Remove the top cover from the data logger.
- c. Locate the Data Format switches on each —12 Series Digital Output PCB, as shown in Figure 612-1.
- d. With reference to Figure 612-2, establish the format of recorded data as follows:
 1. Set switches 0 through 23 to OFF. This establishes the format shown in Figure 612-2.

2. Delete any combinations of unwanted character segments by setting the assigned switches to ON.
3. Set the desired baud rate using switches 16 through 19.
4. If a TTY is used to record data, set switches 12 through 15 to the desired number of readings per line minus 1. For example, a setting of 0000 is equal to 1 reading per recorded line. The total number of characters and space per line cannot exceed the number of columns available on the TTY (80 typical).

NOTE

Set unused switches to OFF.

- e. Align each Digital Output PCB in its selected I/O slot so that the large female connector is toward the rear of the data logger, and the small board-edge connector is toward the bottom of the unit. Push the pcb straight down onto the mating connector.
- f. After the Digital Output PCB(s) is (are) installed, install the top cover.

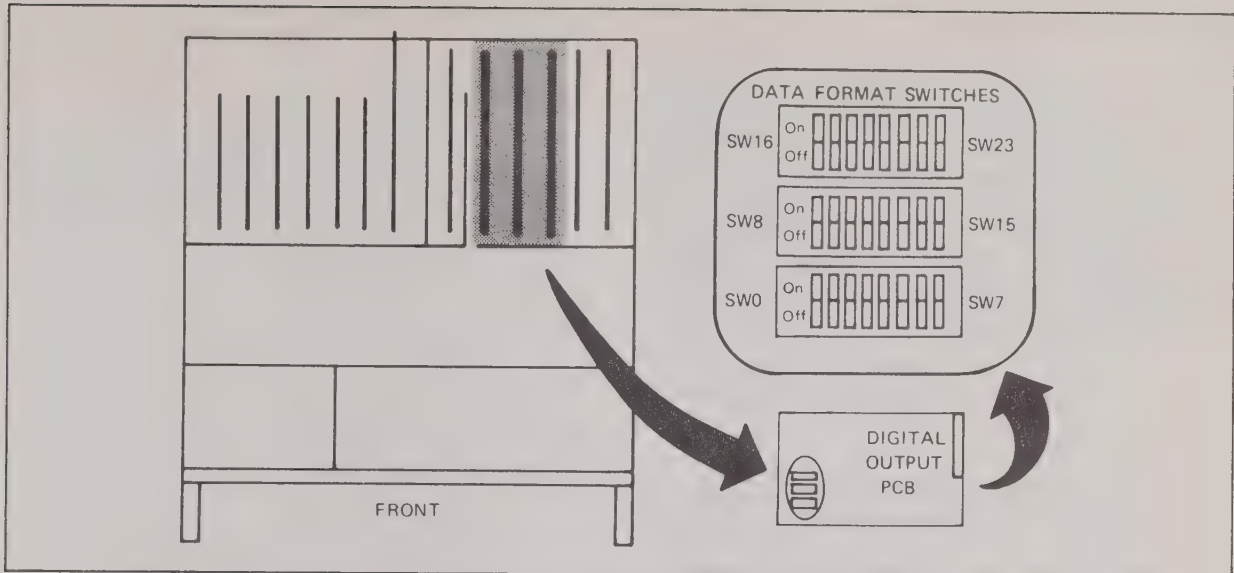


Figure 612-1. Digital Output PCB Installation and Switch Locations

DETAILS OF RECORDED DATA	
DESCRIPTION	RECORDED DATA FORMAT AND CONTROL SWITCH (0 thru 11) ASSIGNMENTS *
START OF SCAN TIME OF YEAR (2240B ONLY)	CR LF D D D : H H : M M : S S CR LF SW 0 SW 1
SCAN COUNTER (2200A) FIXED DATA (2240B)	NOT ON -12C CR LF SP SP FD FD FD FD FD CR LF SW 2 SW 3
DIGITAL INPUT DATA (Option -16)	AC AC SP DD DD DD DD DD DD DD CR LF
MEASUREMENT DATA -NORMAL	CH CH CH SP SP AD AD AD AD AD SP V C CR LF SW 4 SW 5 SW 6 SW 7 SW 8 SW 9 SW 10 SW 11 Floating Decimal Point MEASUREMENT UNITS
MEASUREMENT DATA -ABNORMAL	CH CH CH SP SP SP O L SP SP SP m V C CR LF SW 4 SW 5 SW 6 SW 7 SW 8 SW 9 SW 10 SW 11 OVERLOAD BROKEN THERMOCOUPLE MEASUREMENT UNITS
BAUD RATE AND LINE LENGTH SWITCHES (12 thru 23) The binary code entered is equivalent to one less than the number of recorded measurements per teleprinter line prior to CR LF, EXAMPLE: 0000=1 measurement per line.	
NOT USED SWITCHES 20 21 22 23 110= 1 1 1 1 300= 1 1 0 1 1200= 1 0 1 1 2400= 1 0 0 1 4800= 0 1 1 1 BAUD RATE 1 = ON 16 17 18 19 12 13 14 15 8 4 2 1	
*MNEMONICS AC = Address Code AD = Analog Data CH = Channel Number CR = Carriage Return D = Day Code DD = Digital Input Data FD = Fixed Data H = Hours LF = Line Feed M = Minutes S = Seconds SP = Space	

Figure 612-2. Recorded Data Format and Digital Output PCB Switch Assignments

612-13. Interface Cable

612-14. The interface cable supplied with the Digital Output PCB is designed to interface a specific recording device (see Section 1 of the data logger). If data logger scan sequences are to be initiated manually using the front-panel switches, connect the interface cable between the Digital Output PCB's rear-panel connector and the appropriate recorder. If the scan sequences are to be initiated by a remote input, complete the following procedure prior to connecting the interface cable:

- b. Locate the three coiled wires stowed inside the hood.
- a. Remove the hood from the 50-pin connector which mates with the Digital Output PCB.
- c. Uncoil the wires and identify each prior to reassembling the connector.
 1. Pin 31 — Start
 2. Pin 6 — Scan in Progress (SIP)
 3. Pin 48 — Logic Common
- d. Install the interface cable and connect the remote control lines to the desired source. The function of each line is described below:
 1. START — If the REMOTE switch in the data logger's SCAN CONTROL switch group is depressed, a contact closure to Logic Common or a low TTL/DTL logic level will initiate a scan sequence. If a scan is in progress, the Start input is ignored.
 2. SIP (Scan in Progress) — This TTL output goes low to indicate that a scan is in progress. Start inputs during this period are ignored. SIP also goes low when REMOTE is pressed, and will remain low until an external START is received and the first scan sequence is completed.
 3. LOGIC COMMON — Logic common for the start input and SIP output signals.

NOTE

If a single remote control source is used and more than one Digital Output PCB is installed, it is sufficient to complete the remote control connections on only one interface cable.

612-15. OPERATION

612-16. Once installed in the data logger, the Digital Output PCB requires no operator attention. Instructions for connecting the remote control lines are given earlier under Installation. Refer to the appropriate teleprinter/cassette-recorder instruction manual for additional recorder information.

612-17. The timing required to initiate a remote start depends upon the data logger's configuration and its current activities. Assuming that the REMOTE SCAN CONTROL switch is depressed and an EXTERNAL ENABLE switch is depressed (preferably ALL DATA) the following conditions will assure a start of scan.

- a. Apply a momentary contact closure to ground or a low logic level to the Start input (31). If SIP (6) is initially low (prior to start input), allow the first scan sequence to complete. SIP will return high at the end of the sequence, and will go low for subsequent scan sequences.
- b. While the Scan in Progress output is high (i.e., no keyboard or front panel activity) a negative going Start pulse with a width of ≥ 5 ms will cause a remote start.
- c. Under worst case keyboard activity, a Start pulse ≥ 100 ms is required to ensure a remote start.
- d. If the Start input is held low from the start to finish of a scan sequence, a second scan will be initiated. A continuous scan mode is achieved by holding the Start input low.

612-18. THEORY OF OPERATION

612-19. The Digital Output PCB, as shown in Figure 612-3, is a microprocessor based subsystem which functions as a Controller peripheral to provide the interface necessary to transfer data logger time-of-day, digital data, heading and measurement data (as printed on the internal printer) to an external digital recording device. Any one of several types of recorders can be accommodated by the interface. Among these are: a 20 mA current-loop teleprinter, a paper tape punch, an incremental magnetic tape recorder, or any RS-232C compatible recording device. Once the recorder is defined, the interface pcb can be tailored to meet the interface requirements by the addition of two plug-in ROM's and an interface cable (both are supplied as an integral part of the option). Additional formatting and baud rate requirements (when applicable) are manually selected using a series of 24 switches located on the pcb. (See Installation instructions for switch settings as they

apply to this option.) Provisions are also included which allow a contact closure to ground (or any other low-level input) to serve as a remote start-of-scan signal to the data logger. While a scan is in progress (SIP) an SIP output is generated to indicate that subsequent start inputs will not be accepted until the current scan sequence has been completed.

612-20. Data transfer from the Controller to the external recorder is accomplished in two operations: first, an input transfer sequence, and then, an output transfer sequence. The input transfer sequence is executed under the direction of the Controller and includes the character-serial transfer of 16 four-bit characters from the Controller (via the Data Bus) to a storage location (RAM) on the Digital Output PCB. After the input transfer is complete, the microprocessor on the Digital Output PCB directs the execution of the output transfer sequence. That is, the transfer of data from the storage location to the recording device. Appropriate handshaking is employed to ensure the output transfer is synchronized with the recorder.

612-21. When the Controller is ready to initiate a data transfer it interrogates the status of the Digital Output PCB by placing a binary coded 6 onto Control Bus A. A decoder on the PCB detects the 6 and initiates an appropriate status response via the Data Bus. Table 612-3 lists the possible responses and their meanings.

Table 612-3. Description of Status Response Codes

Status Response		Meaning of Status Response
DB1	DB0	
0	0	Remote Start commanded but transfer in progress. Wait until not Busy.
0	1	Remote Start. Initiate a scan sequence.
1	0	Busy. Data transfer in progress. No action required.
1	1	Initiate a data transfer sequence.

612-22. Upon receiving a binary coded 3 (11) as a status response, the Controller initiates the data transfer sequence by simultaneously placing a binary coded 4 onto Control Bus A, and the first data character (4 bits) onto the Data Bus. A Control Bus Decoder detects the control character (binary coded 4) and responds by generating an Interrupt to the MPU and an input-Enable to the 4-bit Input Register. On the rising edge of the accompanying Out Strobe the Test input to the MPU is driven high and the character on the Data Bus is entered

into the Input Register. As a result of the high Interrupt and Test inputs, the MPU generates a low Interrupt Acknowledge output which is used to provide a Busy response. (Busy is used in the event the status of the output pcb is interrogated prior to completing the entire data transfer to the peripheral device, see Table 612-3.) At the same time the MPU causes the output RAM to place a binary coded 8 onto the Output Bus. The presence of this code plus a subsequent IS pulse (generated by the Memory Interface) enables the contents of the Input Register to be read (via the I/O Bus) by the Memory Interface. On the trailing edge of the IS pulse the MPU's Test input is returned low to complete the first character segment of the 16-character input-transfer sequence.

612-23. Since the binary coded 4 is still present on the Control Bus, the character-serial transfer of data between the Controller and the Memory Interface continues, as previously described, until an entire block of 16 characters has been processed. As each character of input data is read by the System Interface it is also transferred through the MPU (via the MPU Data Bus) into the RAM.

612-24. After the Controller presents the last input character to the Digital Output PCB it removes the binary coded 4 from Control Bus A. With the control code gone the Interrupt input to the MPU goes low to inhibit additional data from being entered into the input register. This completes the initial phase (input data transfer) of the data transfer sequence.

612-25. The output transfer sequence begins as the MPU writes a binary coded 0 onto the Output Bus. A decoder detects the zero and issues an Enable input to the Recorder Status Logic. If the external device is ready to receive data, the Recorder Status Logic will provide a low Ready output which drives the MPU's test input high to indicate that an output transfer may commence. Since the Digital Output PCB is capable of transferring output data in a bit-serial-by-character format, as well as, a bit-parallel-by-character format, each process will be considered separately.

612-26. Bit parallel output data is stored, one character at a time, in a pair of 4-bit output registers. Data transfer to the registers is enabled by the PM input from the Memory Interface, and is entered on the leading edge of the OS pulse. As PM goes low the first output character, including 4-bits of supplementary data (ASCII, BCDIC, and/or EBCDIC), is placed onto address lines A0 through A7. After the character is entered by the subsequent OS pulse, the PM output is returned high. This PM transition arms the Write Punch Logic to allow the rising edge of the next Sync pulse to initiate a Write/Punch output pulse. An appropriate amount of time later a second OS pulse is issued, and the

write/punch output is terminated on the trailing edge of the next Sync pulse. As each bit-parallel character appears on the output lines (D0 through D7) a Parity Generator provides a ninth bit (jumper selectable odd or even) for parity.

612-27. The bit serial output is enabled when the MPU instructs the RAM to place a binary coded 11 onto the Output Bus. Output data is then taken a bit at a time from the MPU's CY output and used to drive an EIA output buffer as well as relay K1. The mercury-wetted contacts of K1 are used to provide a current loop interface (contact closure for a 20 mA current loop).

612-28. The format of output data is established by the setting of 24 rocker switches which comprise a 3 x 8 switch matrix (see Figure 612-3). These switches are scanned at the beginning of each output transfer sequence by the MPU (via the RAM Output Bus) and read into the Memory Interface as six 4-bit characters. To read each character the MPU causes the RAM to sequentially place binary coded numbers 0 through 5

onto the Output Bus. A 1-of-10 decoder detects each number, and effectively scans the matrix switches in groups of four. Thus, each closed switch within a scanned group causes a low level to be placed onto the normally high I/O Bus. (Isolation diodes are provided with each switch to avoid interaction between the various groups of matrix switches.) As each four-bit word appears on the I/O Bus, it is read into the Memory Interface (by an IS pulse).

612-29. The transfer of output data, regardless of format, must be synchronized with the interfaced recorder. This is accomplished by the Recorder Status Logic which detects and reacts to a series of handshaking routines. For example, Ready and Punch inputs/outputs are used to synchronize the operation to a paper tape punch. Similarly, RS-232C compatible recorders employ the Data-Set-Ready and Clear-to-Send inputs. Magnetic tape recorders utilize the Ready and Write lines to record data, and the EOR (end-of-record) and Gap-in-Progress lines to initiate (EOR) a standard inter-record gap, and to indicate its duration (Gap-in-Progress).

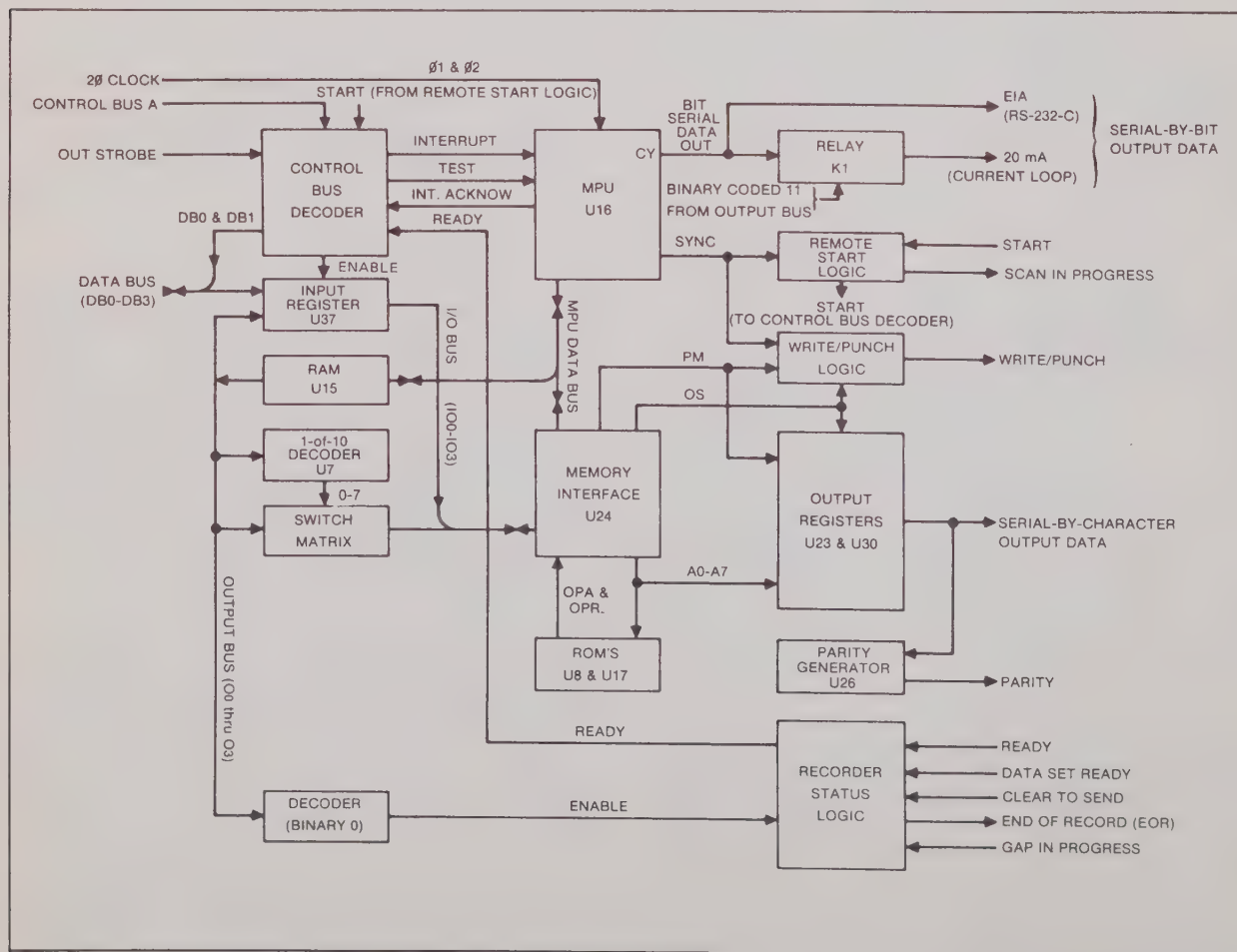


Figure 612-3. Digital Output PCB Simplified Block Diagram

612-30. The Remote Start Logic, upon receipt of an external Start command, alters the Digital Output PCB's status response so as to initiate a data logger scan sequence (see Table 612-3). An acceptable start input is a ≥ 5 ms contact closure to ground while the Scan-in-Progress output is high. When the Controller interrogates the status of the Digital Output PCB (binary coded 6 on Control Bus A) the Remote Start Logic provides a start scan response via the Control Bus Decoder. During the following data transfer sequence the Controller includes both a start-of-scan (binary coded 8) and an end-of-scan (binary coded 9) character with the normal data transfer characters. These two characters are decoded by the 1-of-10 decoder, and used to initiate and terminate the Scan-in-Progress (SIP) output. While the SIP output is active all start inputs are ignored.

612-31. MAINTENANCE

612-32. Access Information

612-33. Refer to the installation instructions given earlier in paragraph 612-11 for Digital Output PCB

access information. Remove the rear panel output connector before attempting to remove the pcb from the data logger.

612-34. Performance Test

612-35. The Digital Output PCB Assembly is most easily tested under normal operating conditions. That is, installed in a functional data logger and interfaced with the recording device it normally drives. Output data format and characters can then be checked by comparing data recorded on the internal printer with hard copy data derived from the external recording device.

612-36. LIST OF REPLACEABLE PARTS

612-37 The lists of replaceable parts for the —12 series of data logger options are given in Tables 612-4, -5, and -6. Refer to Section 5 of the data logger manual for ordering information.

CAUTION

Indicated devices are subject to damage by static discharge.

Table 612-4. -12 Options Final Assembly

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	FINAL ASSEMBLY, -12 SERIES OPTIONS						
-12B	ASR33 INTERFACE 1, 2, 5, 6 				1		
-12C	T1733 KSR/RO INTERFACE 1, 3, 5, 6 				1		
-12L	RS-232C GENERAL PURPOSE TERMINAL INTERFACE 1, 3, 5, 6 						
-12M	RS-232C MODEM INTERFACE 1, 4, 5, 6 						
-12N	TEKTRONIX 4923 AND INTERFACE 1, 4, 5, 6, 8, 9, 10 				1		
-12P	RECORDER, MAG TAPE, TEKTRONIX 4923				1		
	Subassembly item numbers. Descriptions are as follows:						
1	Digital Output PCB Assembly. See Table 612-5.	409254	89536	409524	1		
2	ASR33 Interface Cable Assembly. See Table 612-6.	378349	89536	378349	1		
3	TI Silent 700 Interface Cable Assembly. See Table 612-6.	430785	89536	430785	1		
4	RS-232 Interface Cable Assembly. See Table 612-6.	433045	89536	433045	1		
5	IC, PROM, special program, U8 and U17 (Provide interface description and U number when ordering replacement.)	432757	89536	432757	2		
6	Jumpers, plug-in (10 pack)	373316	89536	373316	1		
8	Recorder, Mag Tape, Tektronix 4923	461848	89536	461848	1		
9	Res, comp, 1k $\pm$ 5% 1/4W (R10 or R11)	148023	01121	CB1025	1		
10	IC, TTL, hex buffer/driver with open collector (U31 and U33)	328021	01295	SN7417N	2		

Table 612-5. Digital Output PCB Assembly

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
1	DIGITAL OUTPUT PCB ASSEMBLY, OPTION -12 (2200A-4014) Figure 612-4.	409524	89536	409524	REF		
C1	Cap, mica, 400 pF +1%, 500V	385328	72136	DM15F401F	1		
C2, C3	Cap, cer, 300 pF +10%, 500V	105734	71590	BB60301KW7W	2		
C4	Cap, Ta, 10 μ F +20%, 20V	330662	56289	196D106X0020- KA1	1		
C5	Cap, cer, 0.68 μ F -20/+80%, 25V	179077	56289	5C023684D8250- B3	1		
CR1, CR3 thru CR28	Diode, Si, switching	203332	07910	1N4448	27	6	
J18	Connector, female, 50 pin	414417	00779	552130-1	1		
K1	Relay, reed	357509	71707	UF-40066	1		
Q1	Xstr, Si, NPN	218396	04713	2N3904	1	1	
R1	Res, comp, 100k $\pm$ 5%, 1/4W	148189	01121	CB1045	1		
R2, R13, R20, R24, R25, R27	Res, comp, 10k $\pm$ 5%, 1/4W	148106	01121	CB1035	6		
R3, R4, R26	Res, comp, 13k $\pm$ 5%, 1/4W	221598	01121	CB1335	3		
R5 thru R9, R12, R14, R16 thru R19	Res, comp, 1k $\pm$ 5%, 1/4W	148023	01121	CB1025	11		
R15	Res, comp, 200 $\pm$ 5%, 1/4W	193482	01121	CB2015	1		
R23	Res, comp 3.3k $\pm$ 5%, 1/4W	148056	01121	CB3325	1		
U1	IC, CMOS, hex buffer 	407759	12040	MM80C97N	1	1	
U2	Res, network	376962	89536	376962	1	1	
U4, U5, U6	Switch Assembly, DIL, 8-position, spdt	414490	00779	435166-5	3	1	

Table 612-5. Digital Output PCB Assembly (cont)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U7	IC, CMOS, bcd-to-decimal decoder (X)	407981	12040	MM74C42N	1	1	
U9	IC, CMOS, dual J-K flip flop (X)	355230	04713	MC14027CP	1	1	
U10, U28	IC, CMOS, quad 2-input NAND gate (X)	355198	04713	MC14011CP	2	1	
U11, U22, U25	IC, CMOS, dual D-type flip flop (X)	340117	04713	MC14013CL	3	1	
U12	IC, CMOS, quad 2-input NOR gate (X)	355172	04713	MC14001CP	1	1	
U13	IC, CMOS, dual 4-input NOR gate (X)	363820	04713	MC14002CP	1	1	
U14, U20, U29	IC, CMOS, hex buffer/converter (X)	355214	04713	MC14007CP	3	1	
U15	IC, PMOS, 320-bit RAM and 4-bit output port (X)	40442	34649	P4002-1	1	1	
U16	IC, MOS, central processor (X)	404418	34649	C4040	1	1	
U18	IC, CMOS, hex buffer/converter (X)	355412	04713	MC14010CP	1	1	
U19	IC, CMOS, triple 3-input NAND gate (X)	375147	04713	MC14023CP	1	1	
U21	IC, CMOS, dual 4-input NAND gate (X)	355206	04713	MC14012CP	1	1	
U23, U30	IC, TTL, tri-state, quad D-type flip flop	408203	12040	DM85651N	2	1	
U24	IC, CMOS, standard memory interface (X)	404434	34649	P4289	1	1	
U26	IC, CMOS, 12-bit parity tree (X)	414060	04713	MC14531CP	1	1	
U27	IC, quad line receiver	414045	12040	LM1489	1	1	
U32	Res, network	358119	89536	358119	1	1	
U34	Res, network	417469	89536	417469	1	1	
U35	IC, TTL, quad 2 input NOR buffer, open collectors	414037	01295	SN74LS33N	1	1	
U36	IC, quad line driver	414052	12040	LM1488	1	1	
U37	IC, CMOS, quad D-type latch (X)	412742	12040	MM74C173N	1	1	

Table 612-5. Digital Output PCB Assembly (cont)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
VR1	Diode, zener	340695	12969	UZ8710	1	1	
	Hardware Kit, connector	435750	00779	552565-1	1		
	Socket, IC, 24-pin DIL	418970	91506	324-AG39D	1		
	Socket, IC, 40-pin DIL	418988	91506	340-AG39D	1		
	Socket, 1 pin	376418	22526	75060-007	11		
	Socket, IC, 14 pin DTL	276527	91506	314-AG39D	2		

Table 612-6. Interface Cable Assemblies

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
2	ASR33 INTERFACE CABLE ASSEMBLY (2200A-4406) Figure 612-5	378349	89536	378349	REF		
P18	Connector, 50 pin	417386	00779	552390-1	1		
	Hood, strain relief	386649	00779	552008-1	1		
3	TI SILENT 700 INTERFACE CABLE ASSEMBLY (2200A-4409) Figure 612-6	430785	89536	430785	REF		
P1	Connector	312579	31746	DB-25S	1		
	Hood, strain relief	436642	31746	DB-51226-1	1		
P18	Connector, 50 pin	417386	00779	552390-1	1		
	Hood, strain relief	386649	00779	552008-1	1		
4	RS-232 INTERFACE CABLE ASSEMBLY (2200A-4408) Figure 612-7	433045	89536	433045	REF		
P1	Connector	312587	31746	DB-25F	1		
	Hood, P1, strain relief	436642	31746	DB-51226-1	1		
P18	Connector, 50 pin	417386	00779	552390-1	1		
	Hood, P18, strain relief	386649	00779	552008-1	1		

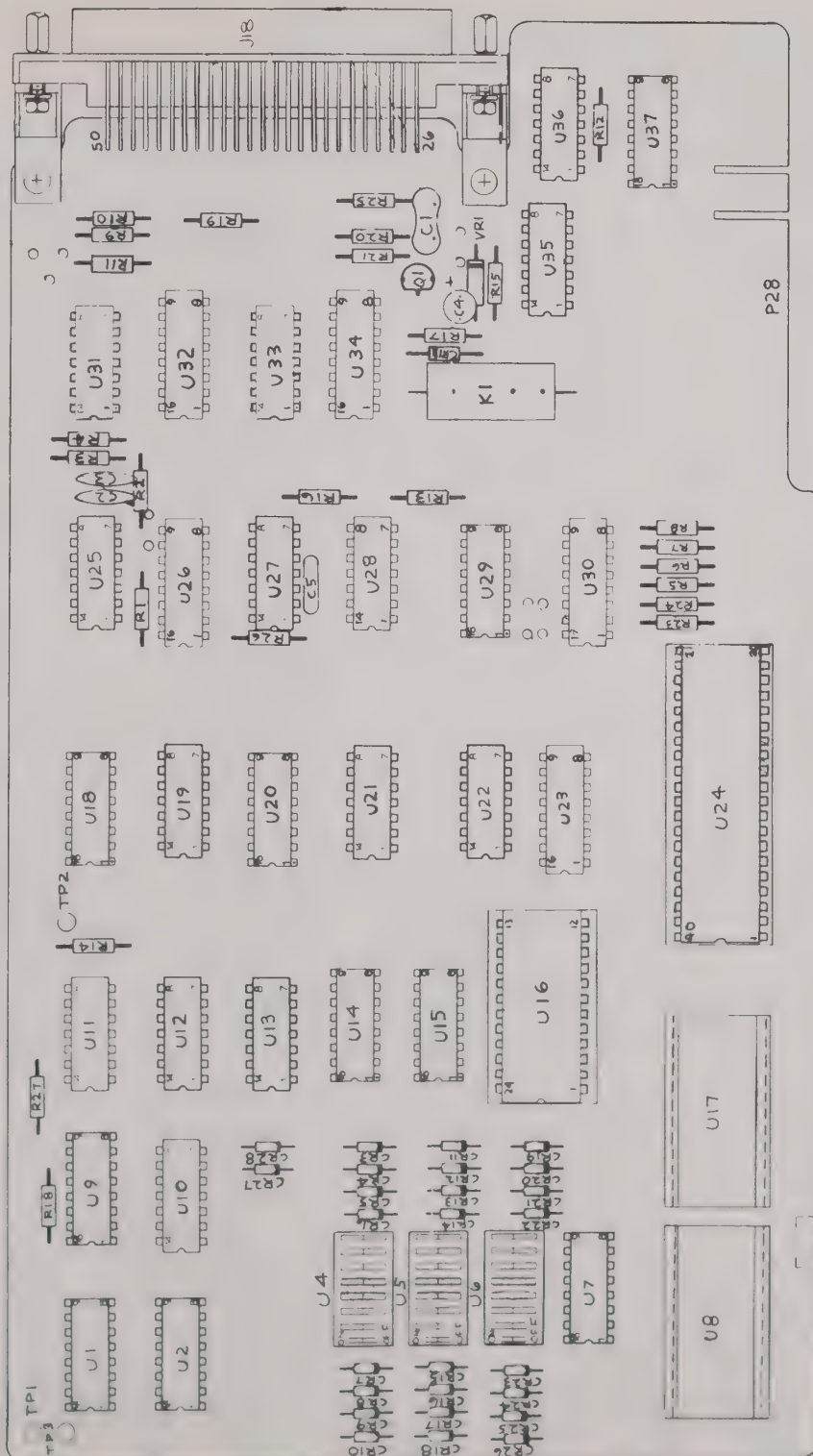


Figure 612-4. Digital Output PCB Assembly

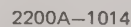
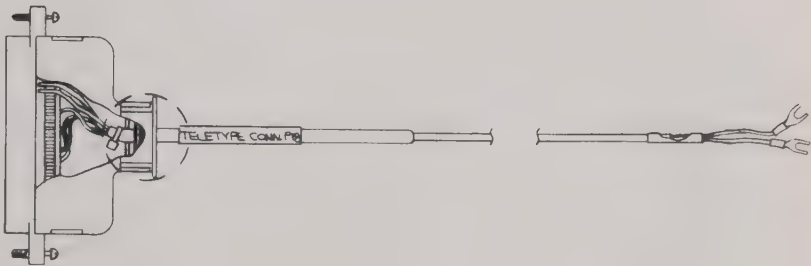


Figure 612-4. Digital Output PCB Assembly (cont)

WIRE LIST	
FROM	TO
P18-1	
-2	
-3	
-4	
-5	
-6	▶
-7	▶
-8	▶
-9	
-10	
-11	
-12	
-13	
-14	
-15	
-16	
-17	
-18	
-19	
-20	
-21	
-22	
-23	
-24	
-25	
-26	
-27	
-28	
-29	
-30	
-31	▶
-32	
-33	
-34	
-35	
-36	
-37	
-38	
-39	
-40	
-41	
-42	
-43	
-44	
-45	
-46	
-47	
-48	▶
-49	
-50	



- ▶ Common connections to one I/O wire.
- ▶ Common connections to other I/O wire.

Figure 612-5. ASR33 Interface Cable Assembly

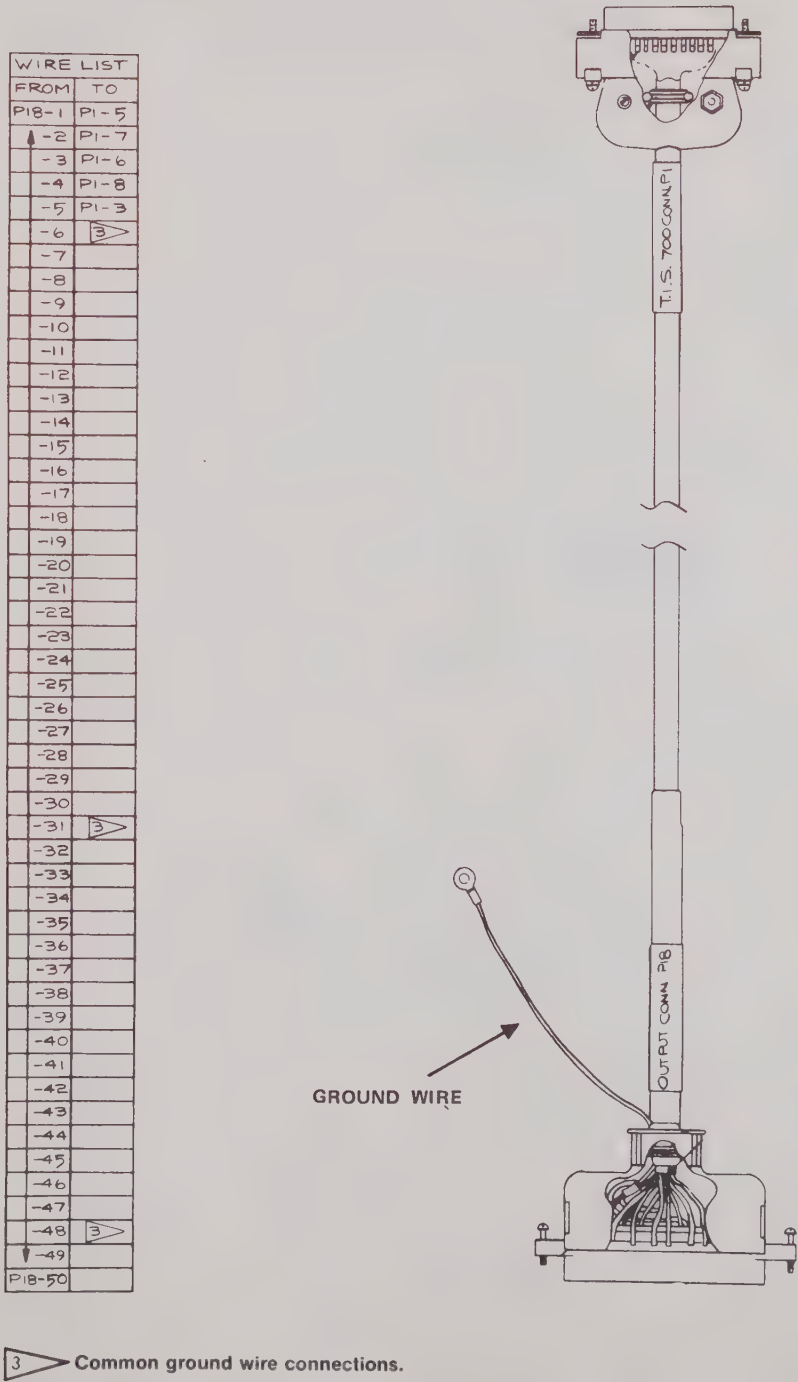


Figure 612-6. T1 Silent 700 Interface Cable Assembly

WIRE LIST	
FROM	TO
P1B-1	
-2	P1-7
-3	P1-4
-4	P1-20
-5	P1-2
-6	3
-7	
-8	
-9	
-10	
-11	
-12	
-13	
-14	
-15	
-16	
-17	P1-6
-18	P1-5
-19	
-20	
-21	
-22	
-23	
-24	
-25	
-26	
-27	
-28	
-29	
-30	
-31	3
-32	
-33	
-34	
-35	
-36	
-37	
-38	
-39	
-40	
-41	
-42	
-43	
-44	
-45	
-46	
-47	
-48	3
-49	
-50	

3 Common ground wire connections.

GROUND WIRE

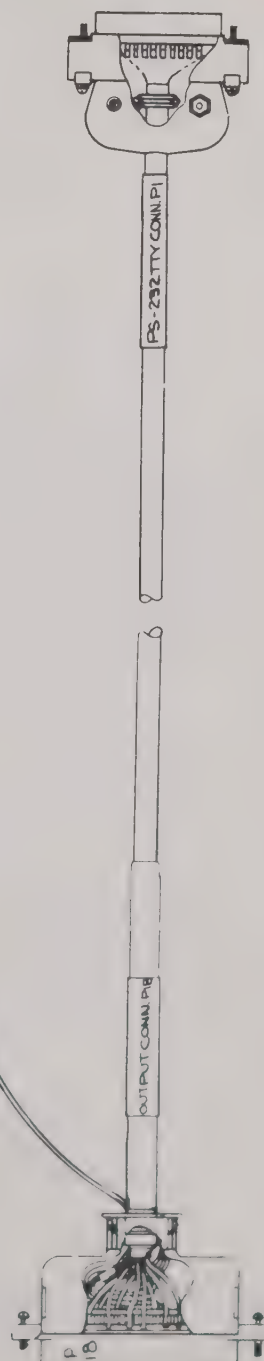


Figure 612-7. RS-232 Interface Cable Assembly

—13 Series

Paper Tape Punch and Cassette Recorder Interface Options

613-1. SCOPE

613-2. The —13 Series Options include Options 13A through 13E, and are described in Section I of the data logger manual. Each option in the 13A through 13C series is compatible with the Facit Model 4070 Paper Tape Punch. Options 13C and 13D are compatible with Facits Model 4203.0005 Cassette Tape Recorder. The information contained herein deals with the Digital Output PCB used to interface these recording devices.

613-3. INTRODUCTION

613-4. The Digital Output PCB is designed to transfer character-serial/bit-parallel data from the data logger to either an external paper tape punch (Facit Model 4070) or an Incremented Interface Recorder. This includes: Time-of-Year (2240A), Fixed Data (2240A), Scan Counter (2200A), Digital Input Data (Option —16), and measurement data. The appropriate carriage-return and line-feed characters are also generated. Provisions are included for initiating a scan sequence using a remote start input.

613-5. A special interface cable and a series of 24 switches located on the pcb are used to tailor the pcb's digital output with the external recorder's digital inputs. The cable is included as part of the option and the user manually sets the switches to define the format of the recorded data. Provisions are included on the pcb for selecting either odd or even parity.

613-6. SPECIFICATIONS

613-7. Specifications for the —13 series of options are given in Table 613-1.

613-8. INSTALLATION

613-9. Digital Output PCB

613-10. Up to three Digital Output PCB's can be mounted in the data loggers I O slots, as shown in Figure 613-1. Install each output pcb as follows:

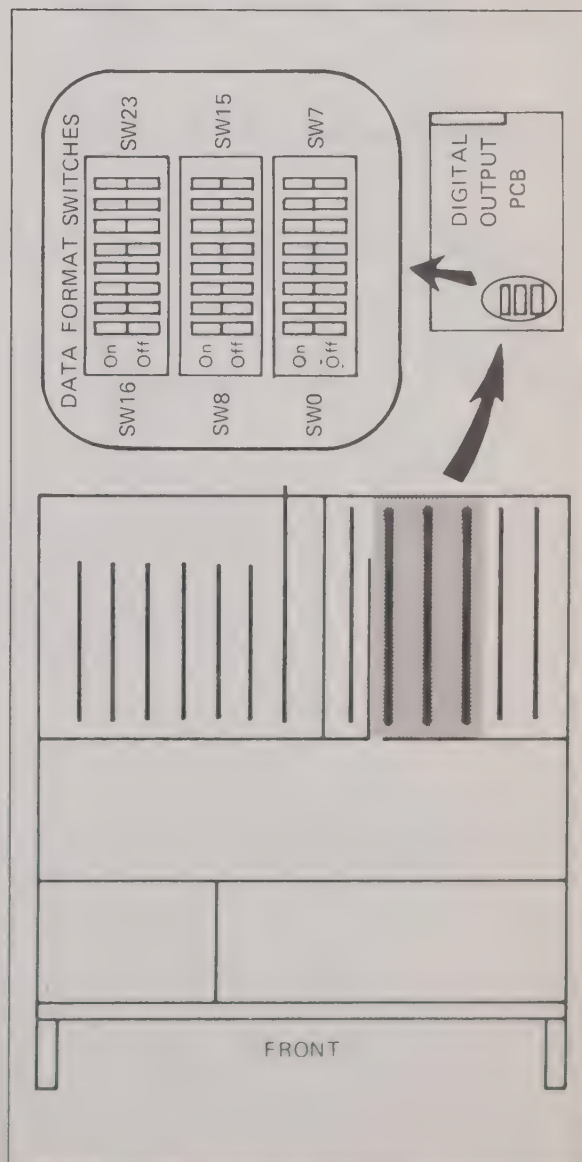


Figure 613-1. Digital Output PCB, Installation and Switch Locations

Table 613-1. —13 Series Options Specifications

Compatibility	Designed to interface the data logger output with the Facit Model 4203.0005. Specify requirements at time-of-purchase using alphabetic suffix as shown in Table 1-2.
Output Format	Character serial
Output Code	ASCII 8-level
Measurements per Line (—13A thru —13C)	1 thru 16, switch selectable.
Characters per Record (—13D thru —13E)	1 thru 2.56, switch selectable.
Word Format	Unwanted word blocks may be deleted by switches on pcb. Word order cannot be changed.
Record Format	@, CR, LF (Carriage Return, Line Feed) Time-of-Day (day, hr, min) CR, LF CR, LF, Fixed Data CR, LF Digital Inputs, CR, LF (—16 Option) Channels, limit, sign, data, range, function, CR, LF

WARNING**REMOVE LINE POWER AND ALL OTHER HIGH VOLTAGE INPUTS TO THE DATA LOGGER BEFORE STARTING THIS PROCEDURE.**

- a. Set the data loggers POWER switch to OFF.
- b. Remove the top cover from the data logger.
- c. Locate the Data Format switches on each Digital Output PCB as shown in Figure 613-1.
- d. With reference to Figure 613-2, establish the format of recorded data as follows:
 1. Set switches 0 through 11 to OFF. This establishes the format shown in Figure 613-2.
 2. Delete any combination of unwanted character segments by setting the appropriate switches to ON.
 3. Refer to Figure 613-2 and set switches 12 through 15 for either the desired number of readings per line (paper tape punch interface) or the desired number of characters per record (incremental cassette tape recorder).
 4. Set unused switches (16 through 23 or 20 through 22) to OFF.
- e. Refer to Figure 613-3 and position the jumpers desired odd or even parity.
- f. Align the Digital Output PCB in the selected I/O slot so that the large female connector is toward the rear of the data logger, and the small board-edge connector is toward the bottom of the unit. Push the pcb straight down onto the mating connector.
- g. After the Digital Output PCB(s) is (are) installed, install the top cover.

613-11. Interface Cable

613-12. The interface cable supplied with the —13 Series Option is designed to interface the Digital Output PCB with the specified recorder; Model 4070 Paper Tape Punch or Model 4203.0005 Cassette Tape Recorder. If the data logger scan sequences are to be manually initiated using the front panel SCAN CONTROL switches, connect the interface cable between the Digital Output PCB's rear-panel connector

and the appropriate recording device. If the scan sequences are to be initiated by a remote input signal, complete the following procedure prior to connecting the interface cable.

- a. Remove the hood from the 50-pin connector which mates with the Digital Output PCB.
- b. Locate the three coiled wires stowed in the hood.
- c. Uncoil the wires and identify each.
 1. Pin 31 — Start
 2. Pin 6 — Scan in Progress (SIP)
 3. Pin 48 — Logic Common
- d. Feed the three wires through the cable port in the connector hood and reassemble the connector.
- e. Install the interface cable and connect the remote control lines to the desired control source. The function of each line is described below:
 1. START — If the REMOTE switch in the data logger's SCAN CONTROL switch group is depressed, a contact closure to Logic Common or a low TTL/DTL logic level will initiate a scan sequence. If a scan is in progress, the Start input is ignored.
 2. SIP — A TTL output that goes low to indicate that a scan is in progress. Start inputs during this period are ignored. SIP also goes low when REMOTE is pressed, and will remain low until an external START is received and the first scan sequence is completed.
 3. LOGIC COMMON — Logic common for the Start input and the SIP output signals.

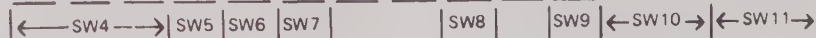
NOTE

If a single remote control source is used and more than one Digital Output PCB is installed, it is sufficient to complete the remote control connections on only one interface cable.

613-13. OPERATION

613-14. Once installed in the data logger, the Digital Output PCB requires no operator attention. Instructions for connecting the remote control lines are given under Installation. Refer to the Facit Instruction Manual for details concerning the external recording device.

DETAILS OF RECORDED DATA

DESCRIPTION	RECORDED DATA FORMAT AND CONTROL SWITCH (0 thru 11) ASSIGNMENTS*
START OF SCAN	@ CR LF
TIME OF YEAR (2240A ONLY)	D D D : H H : M M : S S CR LF 
SCAN COUNTER (2200A) FIXED DATA (2240A)	CR LF SP SP FD FD FD FD FD FD CR LF 
DIGITAL INPUT DATA (Option-16)	AC AC SP DD DD DD DD DD DD DD DD CR LF
MEASUREMENT DATA -NORMAL	$\begin{matrix} > \\ < \end{matrix}$ $\pm$ Floating Decimal Point  $\begin{matrix} V \\ C \end{matrix}$ m C CH CH CH SP SP AD AD AD AD AD AD m SP F SP SP  
MEASUREMENT DATA -ABNORMAL	OVERLOAD $\begin{matrix} O \\ B \end{matrix}$ $\begin{matrix} L \\ T \end{matrix}$ $\begin{matrix} V \\ C \end{matrix}$ m C CH CH CH SP SP SP O B T SP SP SP m SP F CR LF  

OPTIONS -13A thru -13C

RECORDED MEASUREMENTS PER LINE SWITCH SETTINGS(12 thru 15)

Set switches to indicate, in binary, one less than the desired maximum number of recorded measurements per teleprinter line prior to CR LF. For example, 0000= one measurement recorded per teleprinter line. 1=ON

NOT USED									SETTINGS INDICATE MEASUREMENTS PER LINE +1			
SWITCHES	20	21	22	23	16	17	18	19	12	13	14	15
BINARY	—	—	—	—	—	—	—	—	2 ³	2 ²	2 ¹	2 ⁰
EQUIVALENT	—	—	—	—	—	—	—	—	8	4	2	1
DECIMAL	—	—	—	—	—	—	—	—	8	4	2	1
EQUIVALENT	—	—	—	—	—	—	—	—	8	4	2	1

OPTIONS -13D and -13E

CHARACTERS PER RECORD SWITCH SETTINGS(12 thru 19)

Set switches to indicate, in binary, one less than the maximum number of recorded characters per scan sequence. For example, a binary coded 199 is equal to 200 recorded characters per scan sequence 1= ON

NOT USED				SETTINGS INDICATE CHARACTERS PER RECORD +1								
SWITCHES	20	21	22	23	16	17	18	19	12	13	14	15
BINARY	—	—	—	—	2 ⁷	2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰
EQUIVALENT					128	64	32	16	8	4	2	1
DECIMAL	—	—	—	—								
EQUIVALENT												

*MNEMONICS

AC	=	Address Code
AD	=	Analog Data
CH	=	Channel Number
CR	=	Carriage Return
D	=	Day Code
DD	=	Digital Input Data
FD	=	Fixed Data
H	=	Hours
LF	=	Line Feed
M	=	Minutes
S	=	Seconds
SP	=	Space

Figure 613-2. Recorded Data Format and Digital Output PCB Switch Assignments

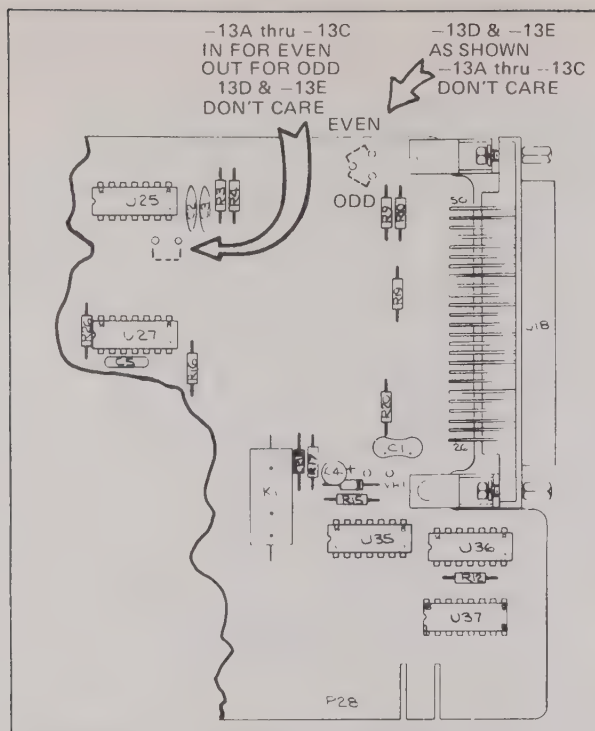


Figure 613-3. Even Parity Jumper Location, -13 Series Options

613-15. The timing required to initiate a remote start depends upon the data logger's configuration and its current activities. Assuming that the REMOTE SCAN CONTROL switch is depressed and an EXTERNAL ENABLE switch is depressed (preferably ALL DATA) the following conditions will assure a start of scan:

- Apply a contact closure to ground or a low logic level to the Start input (31). If SIP (6) is initially low (prior to start input) allow the first scan sequence to complete. SIP will return high at the end of the sequence, and will go low for subsequent scan sequences.
- While the Scan in Progress output is high (i.e., no keyboard or front panel activity) a negative going Start pulse with a width of ≥ 5 ms will cause a remote start.
- Under worst case keyboard activity, a Start pulse, ≥ 100 ms is required to ensure a remote start.
- If the Start input is held low from the start to finish of a scan sequence, a second scan will be initiated. A continuous scan mode is achieved by holding the Start input low.

613-16. THEORY OF OPERATION

613-17. The Digital Output PCB, as shown in Figure 613-4, is a microprocessor based subsystem which functions as a Controller peripheral to provide the interface necessary to transfer data logger time-of-day,

digital data, heading and measurement data (as printed on the internal printer) to an external digital recording device. Any one of several types of recorders can be accommodated by the interface. Among these are: a 20 mA current-loop telprinter, a paper tape punch, an incremental magnetic tape recorder, or any RS-232C compatible recording device. Once the recorder is defined, the interface pcb can be tailored to meet the interface requirements by the addition of two plug-in ROM's and an interface cable (both are supplied as an integral part of the option). Additional formatting and baud rate requirements (when applicable) are manually selected using a series of 24 switches located on the pcb. (See Installation instructions for switch settings as they apply to this option.) Provisions are also included which allow a contact closure to ground (or any other low-level input) to serve as a remote start-of-scan signal to the data logger. While a scan is in progress (SIP) and SIP output is generated to indicate that subsequent start inputs will not be accepted until the current scan sequence has been completed.

613-18. Data transfer from the Controller to the external recorder is accomplished in two operations: first, an input transfer sequence, and then, an output transfer sequence. The input transfer sequence is executed under the direction of the Controller and includes the character-serial transfer of 16 four-bit characters from the Controller (via the Data Bus) to a storage location (RAM) on the Digital Output PCB. After the input transfer is complete, the microprocessor on the Digital Output PCB directs the execution of the output transfer sequence. That is, the transfer of data from the storage location to the recording device. Appropriate handshaking is employed to ensure the output transfer is synchronized with the recorder.

613-19. When the Controller is ready to initiate a data transfer, it interrogates the status of the Digital Output PCB by placing a binary coded 6 onto Control Bus A. A decoder on the PCB detects the 6 and initiates an appropriate status response via the Data Bus. Table 613-2 lists the possible responses and their meanings.

Table 613-2. Description of Status Response Codes

Status Response		Meaning of Status Response
DB1	DB0	
0	0	Remote Start commanded but transfer in progress. Wait until not Busy.
0	1	Remote Start. Initiate a scan sequence.
1	0	Busy. Data transfer in progress. No action required.
1	1	Initiate a data transfer sequence.

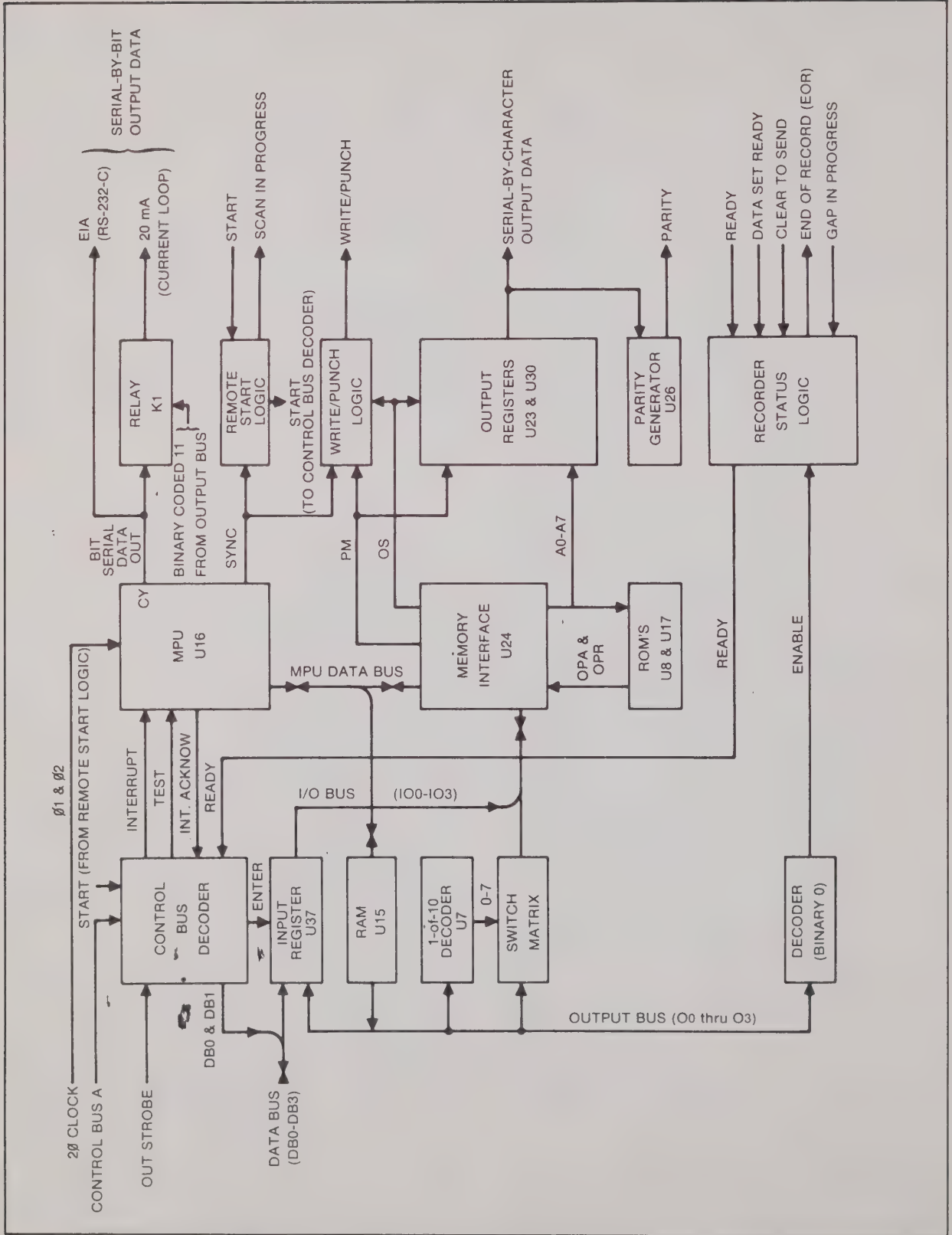


Figure 613-4. Digital Output PCB Simplified Block Diagram

613-20. Upon receiving a binary coded 3 (11) as a status response, the Controller initiates the data transfer sequence by simultaneously placing a binary coded 4 onto Control Bus A, and the first data character (4 bits) onto the Data Bus. A Control Bus Decoder detects the control character (binary coded 4) and responds by generating an interrupt to the MPU and an input-Enable to the 4-bit input Register. On the rising edge of the accompanying Out Strobe the Test input to the MPU is driven high and the character on the Data Bus is entered into the Input Register. As a result of the high Interrupt and Test inputs the MPU generates a low Interrupt Acknowledge output which is used to provide a Busy response. (Busy is used in the event the status of the output pcb is interrogated prior to completing the entire data transfer to the peripheral devices, see Table 613-3). At the same time the MPU causes the output RAM to place a binary coded 8 onto the Output Bus. The presence of this code plus a subsequent IS pulse (generated by the Memory Interface) enables the contents of the Input Register to be read (via the I/O Bus) by the Memory Interface. On the trailing edge of the IS pulse the MPU's Test input is returned low to complete the first character segment of the 16-character input-transfer sequence.

613-21. Since the binary coded 4 is still present on the Control Bus, the character-serial transfer of data between the Controller and the Memory Interface continues, as previously described, until an entire block of 16 characters has been processed. As each character of input data is read by the System Interface it is also transferred through the MPU (via the MPU Data Bus) into the RAM.

613-22. After the Controller presents the last input character to the Digital Output PCB it removes the binary coded 4 from Control Bus A. With the control code gone the Interrupt input to the MPU goes low to inhibit additional data from being entered into the input register. This completes the initial phase (input data transfer) of the data transfer sequence.

613-23. The output transfer sequence begins as the MPU writes a binary coded 0 onto the Output Bus. A decoder detects the zero and issues an Enable input to the Recorder Status Logic. If the external device is ready to receive data, the Recorder Status Logic will provide a low Ready output which drives the MPU's test input high to indicate that an output transfer may commence. Since the Digital Output PCB is capable of transferring output data in a bit-serial-by-character format, as well as, a bit-parallel-by-character format, each process will be considered separately.

613-24. Bit parallel output data is stored, one character at a time, in a pair of 4-bit output registers. Data transfer to the registers is enabled by the PM input

from the Memory Interface, and is entered on the leading edge of the OS pulse. As PM goes low the first output character, including 4-bits of supplementary data (ASCII, BCDIC, and/or EBCDIC), is placed onto address lines A0 through A7. After the character is entered by the subsequent OS pulse, the PM output is returned high. This PM transition arms the Write/Punch Logic to allow the rising edge of the next Sync pulse to initiate a Write/Punch output pulse. An appropriate amount of time later a second OS pulse is issued, and the write/punch output is terminated on the trailing edge of the next Sync pulse. As each bit-parallel character appears on the output lines (D0 through D7) a Parity Generator provides a ninth bit (jumper selectable odd or even) for parity.

613-25. The bit serial output is enabled when the MPU instructs the RAM to place a binary coded 11 onto the Output Bus. Output data is then taken a bit at a time from the MPU's CY output and used to drive an EIA output buffer as well as relay K1. The mercury-wetted contacts of K1 are used to provide a current loop interface (contact closure for a 20 mA current loop).

613-26. The format of output data is established by the setting of 24 rocker switches which comprise a 3 x 8 switch matrix (see Figure 613-4). These switches are scanned at the beginning of each output transfer sequence by the MPU (via the RAM Output Bus) and read into the memory Interface as six 4-bit characters. To read each character the MPU causes the RAM to sequentially place binary coded numbers 0 through 5 onto the Output Bus. A 1-of-10 decoder detects each number, and effectively scans the matrix switches in groups of four. Thus, each closed switch within a scanned group causes a low level to be placed onto the normally high I/O Bus. (Isolation diodes are provided with each switch to avoid interaction between the various groups of matrix switches.) As each four-bit word appears on the I/O Bus, it is read into the Memory Interface (by an IS pulse).

613-27. The transfer of output data, regardless of format, must be synchronized with the interfaced recorder. This is accomplished by the Recorder Status Logic which detects and reacts to a series of handshaking routines. For example, Ready and Punch inputs/outputs are used to synchronize the operation to a paper tape punch. Similarly, RS-232C compatible recorders employ the Data-Set-Ready and Clear-to-Send inputs. Magnetic tape recorders utilize the Ready and Write lines to record data, and the EOR (end-of-record) and Gap-in-Progress lines to initiate (EOR) a standard inter-record gap, and to indicate its duration (Gap-in-Progress).

613-28. The Remote Start Logic, upon receipt of an external Start command, alters the Digital Output PCB's status response so as to initiate a data logger scan

sequence (see Table 613-2. An acceptable start input is a ≥ 5 ms contact closure to ground while the Scan-in-Progress output is high. When the Controller interrogates the status of the Digital Output PCB (binary coded 6 on Control Bus A) the Remote Start Logic provides a start scan response via the Control Bus Decoder. During the following data transfer sequence the Controller includes both a start-of-scan (binary coded 8) and an end-of-scan (binary coded 9) character with the normal data transfer characters. These two characters are decoded by the 1-of-10 decoder, and used to initiate and terminate the Scan-in-Progress (SIP) output. While the SIP output is active all start inputs are ignored.

613-29. MAINTENANCE

613-30. Access Information

613-31. Refer to the installation instructions given earlier in paragraph 613-8 for Digital Output PCB access information. Remove the rear panel output connector before attempting to remove the pcb from the data logger.

613-32. Performance Test

613-33. The Digital Output PCB Assembly is most easily tested under normal operating conditions. That is, installed in a functional data logger and interfaced with the recording device it normally drives. Output data format and characters can then be checked by comparing data recorded on the internal printer with hard copy data derived from the external recording device.

613-34. LIST OF REPLACEABLE PARTS

613-35. The lists of replaceable parts for the -14 series of data logger options are given in Tables 613-3, -4, and -5. Refer to Section 5 of the data logger manual for ordering information.



CAUTION

Indicated devices are subject to damage by static discharge.

Table 613-3. —13 Options Final Assembly

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	FINAL ASSEMBLY, —13 SERIES OPTIONS						
-13A	FACIT 4070 (BENCH TOP) AND INTERFACE 1, 2, 4, 5, 6 				1		
13B	FACIT 4070 (RACK MOUNT) AND INTERFACE 1, 2, 4, 5, 7 				1		
-13C	FACIT 4070 INTERFACE 1, 2, 4, 5 				1		
13D	FACIT 4203.0005 AND INTERFACE 1, 3, 4, 5, 8 				1		
-13E	FACIT 4203.0005 INTERFACE 1, 3, 4, 5 				1		
	Subassembly item numbers. Descriptions are as follows:						
1	Digital Output PCB Assembly. See Table 613-4.	409524	89536	409524	1		
2	Paper Tape Punch Interface Cable Assembly. See Table 613-5.	377531	89536	377531	1		
3	Facit 4203.0005 Interface Cable Assembly. See Table 613-5.	449694	89536	449694	1		
4	IC, PROM, special program, U8 and U17 (Provide interface description and U number when ordering replacement.)	432757	89536	432757	2		
5	Jumper, plug-in (10 pack)	373316	89536	373316	1		
6	Paper Tape Punch, bench top, Facit 4070-0004	435453	95011	4070-0004	1		
7	Paper Tape Punch, rack mount, Facit 4070-0024	435461	95011	4070-0024	1		
8	Cassette Tape Recorder, Facit 4203.0005	446732	95011	4203.0005	1		

Table 613-4. Digital Output PCB Assembly (Continued)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
1	DIGITAL OUTPUT PCB ASSEMBLY, OPTION -13 (2200A-4014) Figure 613-5	409524	89536	409524	REF		
C1	Cap, mica, 400 pF $\pm 1\%$, 500V	385328	72136	DM15F401F	1		
C2, C3	Cap, cer, 300 pF $\pm 10\%$, 500V	105734	71590	BB60301KW7W	2		
C4	Cap, Ta, 10 μ F $\pm 20\%$, 20V	330662	56289	196D106X0020- KA1	1		
C5	Cap, cer, 0.68 μ F -20/+80%, 25V	179077	56289	5C023684D8250- B3	1		
CR1, CR3 thru CR28	Diode, Si, switching	203332	07910	1N4448	27	6	
J18	Connector, female, 50 pin	414417	00779	552130-1	1		
K1	Relay, reed	357509	71707	UF-40066	1		
Q1	Xstr, Si, NPN	218396	04713	2N3904	1	1	
R1	Res, comp, 100k $\pm 5\%$, 1/4W	148189	01121	CB1045	1		
R2, R13, R20, R24, R25, R27	Res, comp, 10k $\pm 5\%$, 1/4W	148106	01121	DB1035	6		
R3, R4, R26	Res, comp, 13k $\pm 5\%$, 1/4W	221598	01121	CB1335	3		
R5 thru R10, R12, R14, R16, thru R19	Res, comp, 1k $\pm 5\%$, 1/4W	148023	01121	CB1025	12		
R15	Res, comp, 200 $\pm 5\%$, 1/4W	193482	01121	CB2015	1		
R23	Res, comp, 3.3k $\pm 5\%$, 1/4W	148056	01121	CB3325	1		
U1	IC, CMOS, hex buffer 	407759	12040	MM80C97N	1	1	
U2	Res, network	376962	89536	376962	1	1	
U4, U5, U6	Switch Assembly, DIL, 8-position, spdt	414490	00779	435166-5	3	1	

Table 613-4. Digital Output PCB Assembly (Continued)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U7	IC, CMOS, bcd-to-decimal decoder (X)	407981	12040	MM74C42N	1	1	
U9	IC, CMOS, dual J-K flip flop (X)	355230	04713	MC14027CP	1	1	
U10, U28	IC, CMOS, quad 2-input NAND gate (X)	355198	04713	MC14011CP	2	1	
U11, U22, U25	IC, CMOS, dual D-type flip flop (X)	340117	04713	MC14013CL	3	1	
U12	IC, CMOS, quad 2-input NOR gate (X)	355172	04713	MC14001CP	1	1	
U13	IC, CMOS, dual 4-input NOR gate (X)	363820	04713	MC14002CP	1	1	
U14, U20, U29	IC, CMOS, hex buffer/converter (X)	355214	04713	MC14009CP	3	1	
U15	IC, PMOS, 320 bit RAM and 4-bit output port (X)	404442	34649	P4002-1	1	1	
U16	IC, MOS, central processor (X)	404418	34649	C4040	1	1	
U18	IC, CMOS, hex buffer/converter (X)	355412	04713	MC14010CP	1	1	
U19	IC, CMOS, triple 3-input NAND gate (X)	375147	04713	MC14023CP	1	1	
U21	IC, CMOS, dual 4-input NAND gate (X)	355206	04713	MC14012CP	1	1	
U23, U30	IC, TTL, tri-state, quad D-type flip flop	408203	12040	DM85L51N	2	1	
U24	IC, CMOS, standard memory interface (X)	404434	34649	P4289	1	1	
U26	IC, CMOS, 12-bit parity tree (X)	414060	04713	MC14531CP	1	1	
U27	IC, quad line receiver	414045	12040	LM1489	1	1	
U31, U33	IC, TTL, hex buffer/driver with open	328021	01295	SN7417N	2	1	
U32	Res, network	358119	89536	358119	1	1	
U34	Res, network	417469	89536	417469	1	1	
U35	IC, TTL, quad 2-input NOR buffer, open collectors	414037	01295	SN74LS33N	1	1	
U36	IC, quad line driver	414052	12040	LM1488	1	1	
U37	IC, CMOS, quad D-type latch (X)	412742	12040	MM74C173N	1	1	

Table 613-4. Digital Output PCB Assembly (Concluded)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
VR1	Diode, zener	340695	12969	UZ8710	1	1	
	Hardware Kit, connector	435750	00779	552565-1	1		
	Socket, IC, 24-pin DIL	418970	91506	324-AG39D	1		
	Socket, IC, 40-pin DIL	418988	91506	340-AG39D	1		
	Socket, 1 pin	376418	22526	75060-007	11		

Table 613-5. Interface Cable Assemblies.

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
2	PAPER TAPE PUNCH INTERFACE CABLE ASSEMBLY (2200A-4403) Figure 613-6	377531	89536	377531	REF		
P1	Connector	312587	31746	DB-25F	1		
	Hood, strain relief, right angle	352385	31746	DB51213-1	1		
P18	Connector, 50 pin	417386	00779	552390-1	1		
	Hood, P18, strain relief	386649	00779	552008-1	1		
3	FACIT 4203.0005 INTERFACE CABLE ASSEMBLY (2200A-4410) Figure 613-7	449694	89536	449694	REF		
P1	Connector Assembly	446971	95011	15.080.790.00	1		
P18	Connector, 50 pin	417386	00779	552390-1	1		
	Hood, strain relief	386649	00779	552008-1	1		

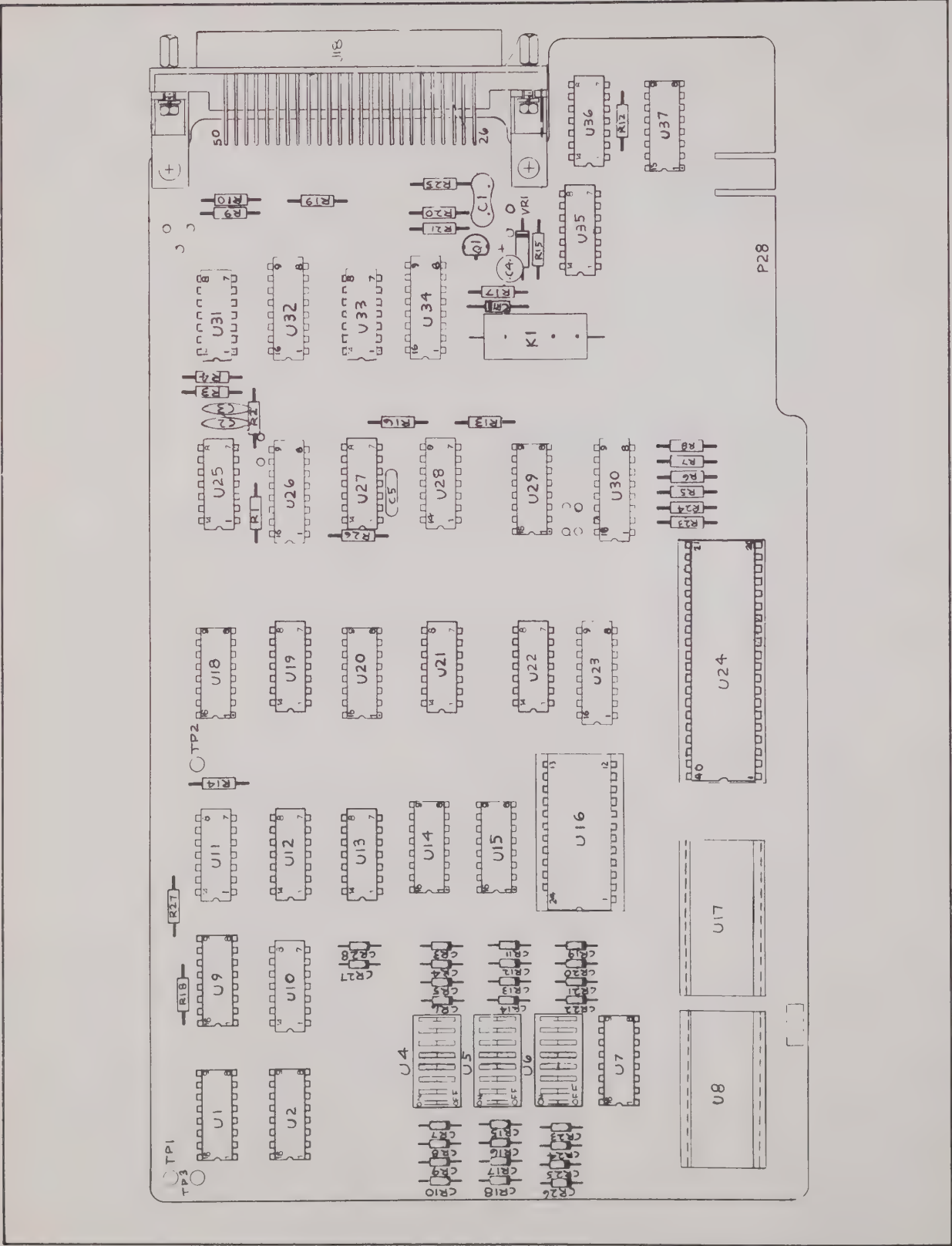


Figure 613-5. Digital Output Interface PCB Assembly (2200A-1014) (Sheet 1 of 2)

613-15

WIRE LIST		
FROM		TO
P18-1		
-2		P1-25
-3		P1-9
-4		
-5		
-6	3	
-7		
-8		
-9		
-10		
-11		
-12		
-13		P1-1
-14		P1-4
-15		P1-6
-16		P1-7
-17		
-18		
-19		P1-12
-20		P1-11
-21		
-22		P1-10
-23		
-24		
-25		
-26		
-27		
-28		
-29		
-30		
-31	3	
-32		
-33		
-34		
-35		
-36		
-37		P1-8
-38		P1-2
-39		P1-3
-40		P1-5
-41		
-42		
-43		
-44		
-45		
-46		
-47		
-48	3	
-49		
P18-50		

3 Common ground wire connections

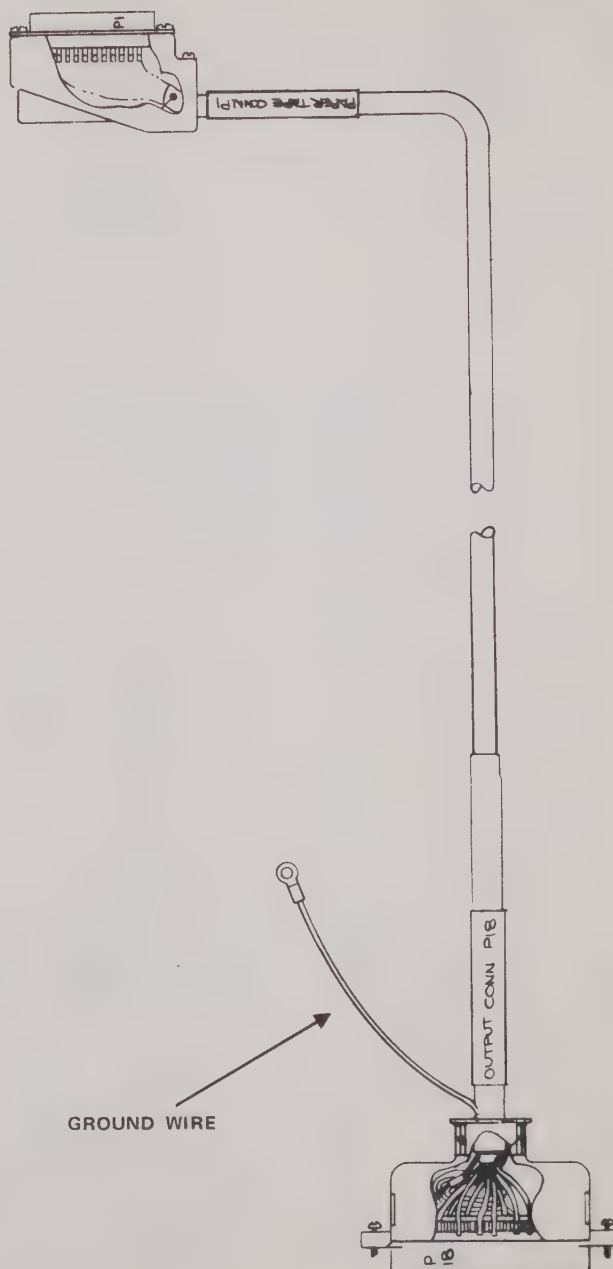
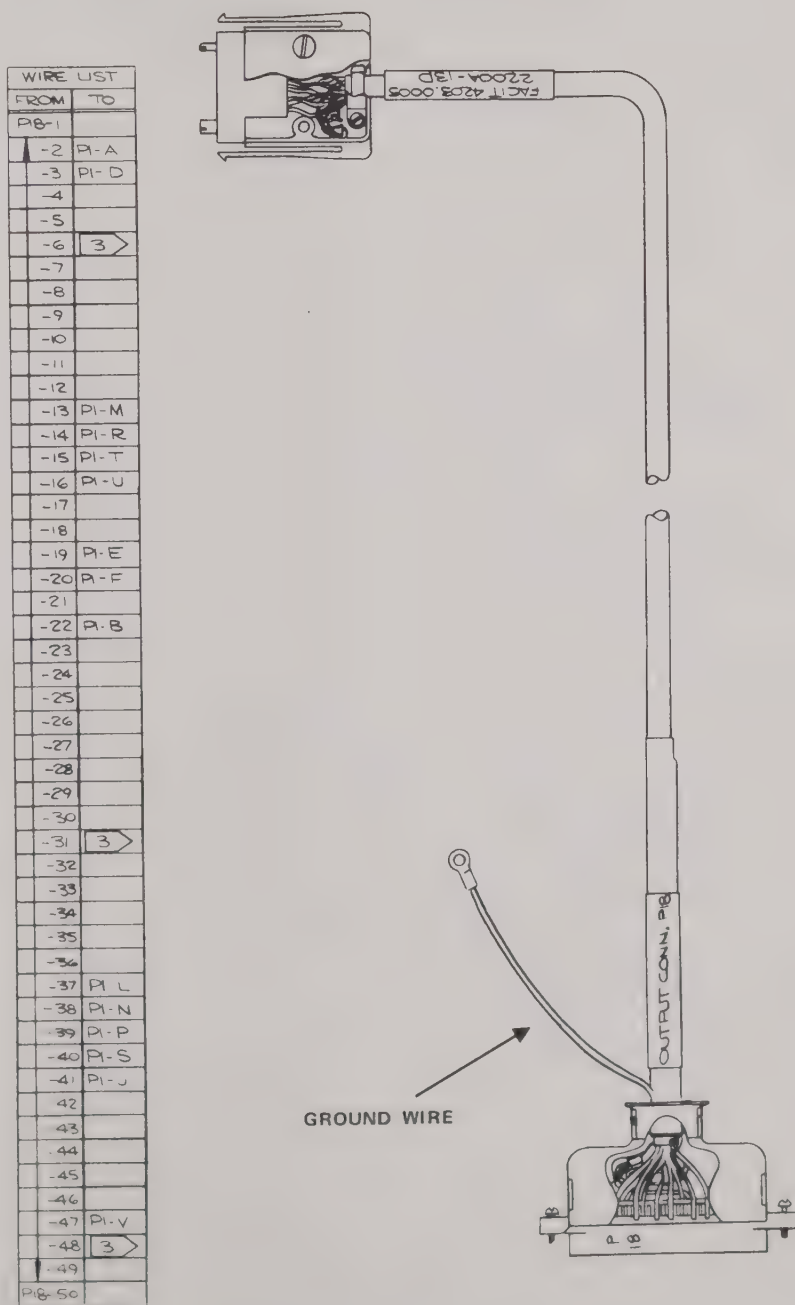


Figure 613-6. Paper Tape Punch Interface Cable Assembly (2200A-4403)



3 > Common ground wire connections

Figure 613-7. Facit 4203.0005 Interface Cable Assembly (2200A-4410)

—14 Series Magnetic Tape Interface Options

614-1. SCOPE

614-2. The —14 Series Options include Options —14A through —14K, and are described in Table 614-1. Each option in the series is compatible with a Kennedy Magnetic Tape Recorder. The information contained herein deals with the basic Digital Output PCB used to interface these recorders.

614-3. INTRODUCTION

614-4. The Digital Output PCB is designed to transfer character-serial/bit-parallel data from the data logger to an external Kennedy Magnetic Tape Recorder. This includes: Time-of-Year (2240B), Fixed Data (2240B), Scan Counter (2200A), Digital Input Data (Option —16), and measurement data. The appropriate

carriage-return and line-feed characters are also generated. Provisions are included for initiating a scan sequence using a remote Start input.

614-5. A unique interface cable and a series of 24 switches on the pcb are used to tailor the digital output with the recorder. The cable is included as part of the option. The switches are set by the user to define baud rate and data format.

614-6. The Digital Output PCB transfers ASCII, BCDIC and EBCDIC coded characters to the recorder, along with a write pulse. On some units odd or even parity can be selected by positioning a jumper wire on the pcb. On others, it is fixed at odd parity by the recorder. The pcb is shipped from the factory with the odd parity jumper installed.

Table 614-1. Configuration of —14 Option

OPTION NO	DESCRIPTION	TRACKS *	PARITY (ODD/EVEN)	OPTION COMPONENTS (INDICATED BY •)		
				PCB	CABLE	RECORDER
—14A	Kennedy 1600/5 and Interface	7	Selectable	•	•	•
—14B	Kennedy 1610/5 and Interface	7	Selectable	•	•	•
—14C	Kennedy 1600/360 and Interface	9	Odd	•	•	•
—14D	Kennedy 1610/360 and Interface	9	Odd	•	•	•
—14E	Kennedy 1600/5 or 1610/5 Interface	7	Selectable	•	•	
—14G	Kennedy 1600/360 or 1610/360 Interface	9	Odd	•	•	
—14H	Kennedy 9832—7 and Interface	7	Selectable	•	•	•
—14I	Kennedy 9832—7 Interface	7	Selectable	•	•	
—14J	Kennedy 9832—9 and Interface	9	Odd	•	•	•
—14K	Kennedy 9832—9 Interface	9	Odd	•	•	
* 7 track = BCDIC or ASCII 9 track = EBCDIC or ASCII						

614-7. After a preset number of characters (switch selectable) have been transferred to the recorder, the Digital Output PCB generates an Inter-Record Gap (IRG) command. The recorder responds by generating a standard IRG and returning a Gap-In-Progress signal to inhibit a data transfer during the IRG generation. If the scan mode is changed before the specified number of characters have been transferred, the Digital Output PCB will insert a \$ character into the record until the character count is satisfied.

614-8. SPECIFICATIONS

614-9. Specifications for the —14 Series of options are given in Table 614-2.

Table 614-2. —14 Series Options Specifications

Compatibility	Specify at time-of-purchase using alphabetic suffix as shown in Table 614-1
Output Format	Character serial
Output Levels	TTL compatible (positive true)
Output Code	BCDIC, EBCDIC or ASCII
Record Format	@CR, LF (Carriage Return, Line Feed) Time-of-Day (day, hr., min., s) CR, LF CR, LF, Fixed Data CR, LF Digital Inputs, CR, LF (—16 Option) Channels, limit, sign, data, function, CR, LF
Word Format	Unwanted word blocks may be deleted by switches on pcb. Word order cannot be changed.
Physical Record Length	Fixed. 1 to 4096 characters, switch selectable on pcb.

614-10. INSTALLATION

614-11. Digital Output PCB

614-12. Up to three Digital Output PCB's can be mounted in the data logger's I/O slots, as shown in Figure 614-1. Install each —14 Series pcb as follows:

WARNING

REMOVE LINE POWER AND ALL OTHER HIGH VOLTAGE INPUTS TO THE DATA LOGGER BEFORE STARTING THIS PROCEDURE.

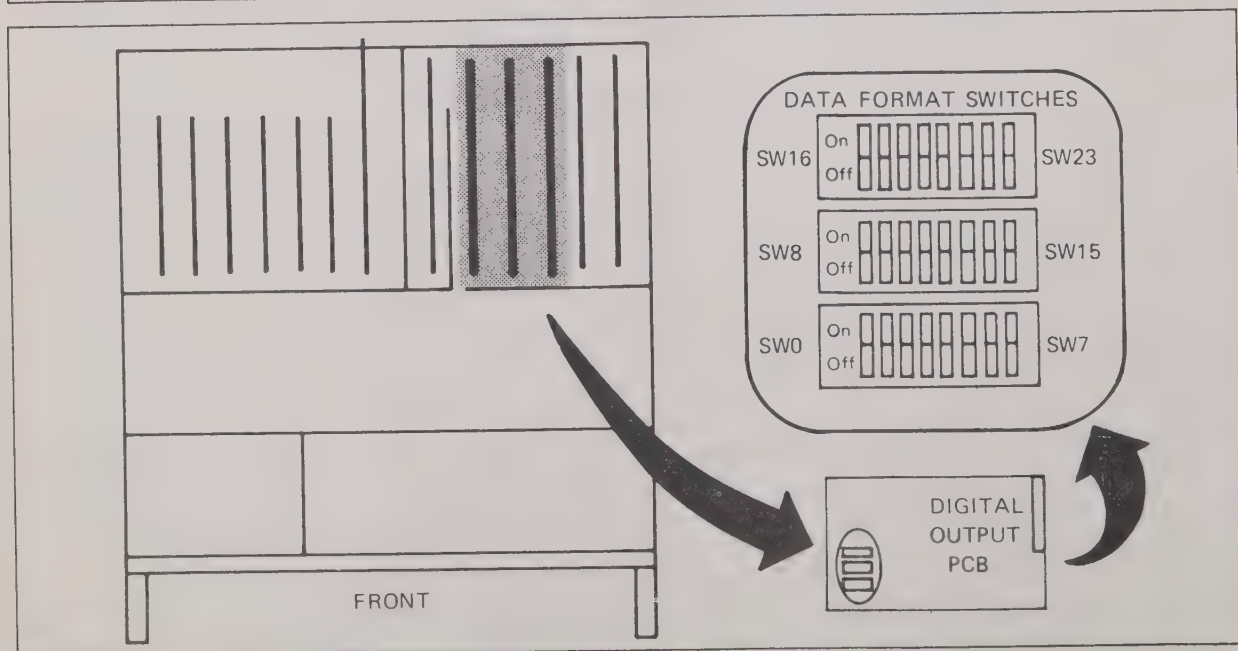


Figure 614-1. Digital Output PCB, Installation and Switch Locations

- a. Set the data loggers POWER switch to OFF.
- b. Remove the top cover from the data logger.
- c. Locate the Data Format switches on each —14 Series Digital Output PCB, as shown in Figure 614-1.
- d. With reference to Figure 614-2, establish the format of recorded data as follows:
 1. Set switches 0 through 23 to OFF. This establishes the format shown in Figure 614-2.
 2. Delete any combination of unwanted character segments by setting the appropriate switches to ON.
 3. Set switches 12 through 23 to indicate (in binary) one less than the maximum

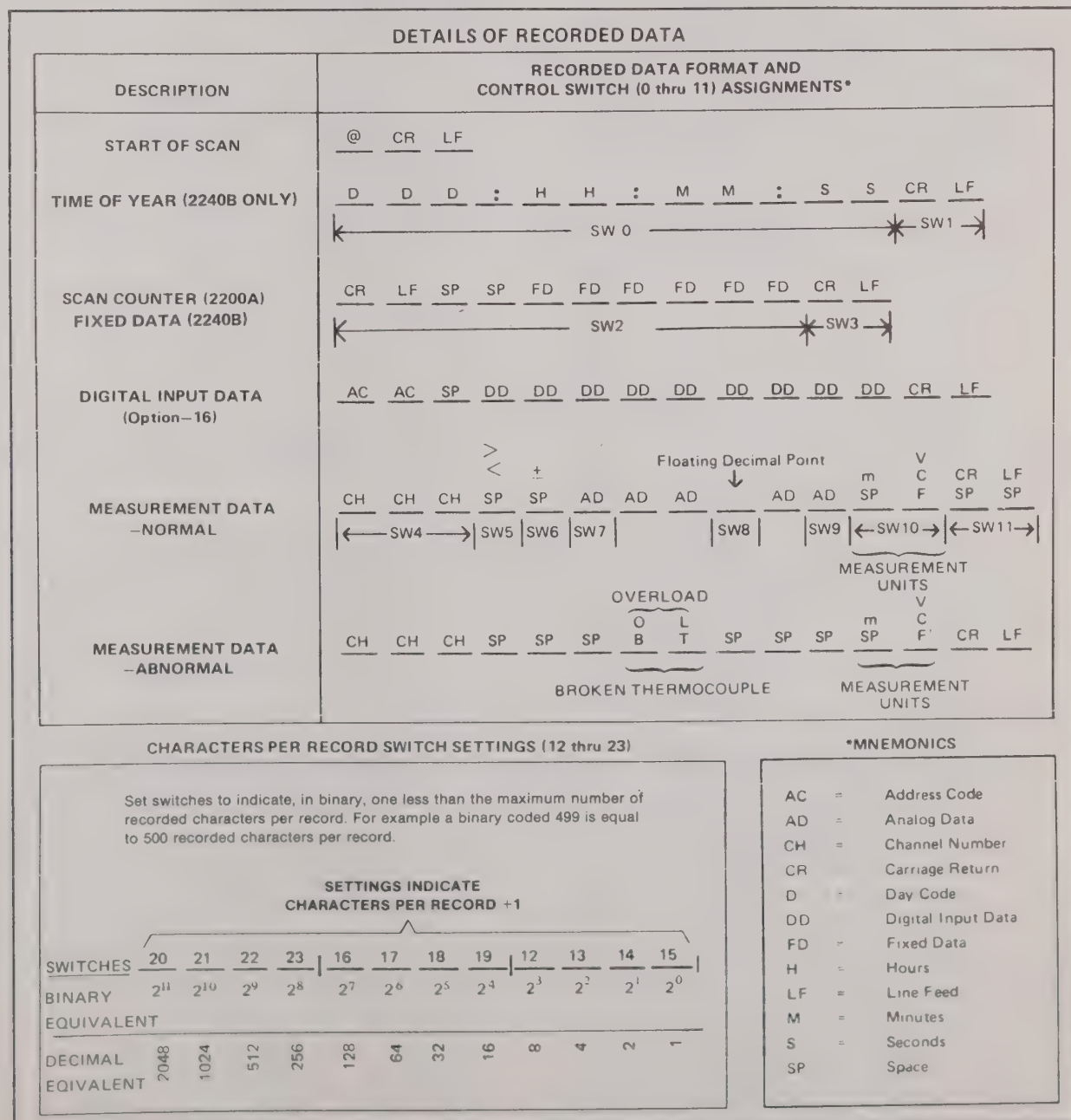


Figure 614-2. Recorded Data Format and Digital Output PCB Switch Assignments

number of characters to be recorded during a scan sequence. One (binary coded zero) to 4096 (binary coded 4095) characters can be selected (1 = ON).

- e. Refer to Figure 614-3 and check to ensure that the parity jumper is properly positioned. If necessary, reposition the jumper to obtain the desired odd or even parity.
- f. Align the Digital Output PCB in the selected I/O slot so that the large female connector is toward the rear of the data logger, and the small board-edge connector is toward the bottom of the unit. Push the pcb straight down onto the mating connector.
- g. After the Digital Output PCB(s) is (are) installed, install the top cover.

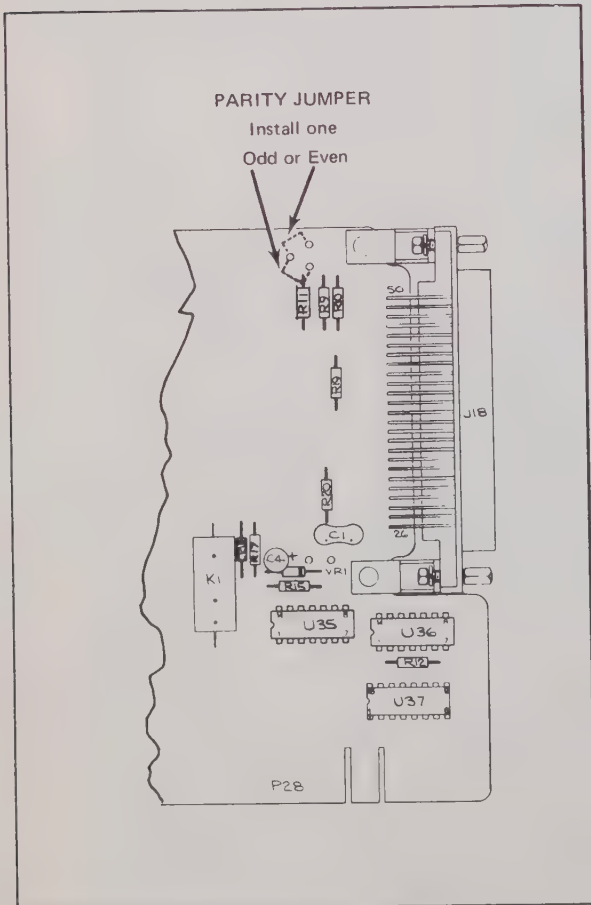


Figure 614-3. Parity Jumper Location, -14 Series Options

614-13. Interface Cable

614-4. The interface cable supplied with the -14 Series Options is designed to connect the Digital Output PCB to the appropriate Kennedy Magnetic Tape Recorder. If the data logger scan sequences are to be manually initiated using the front-panel switches, connect the interface cable between the Digital Output PCB's rear-panel connector and the tape recorder. If the scan sequence is to be initiated by a remote input, complete the following procedure prior to connecting the interface cable:

- a. Remove the hood from the 50-pin connector that mates with the Digital Output PCB.
- b. Locate the three coiled wires stowed in the hood.
- c. Uncoil the wires and identify each prior to reassembling the connector.
 1. Pin 31 — Start
 2. Pin 6 — Scan in Progress (SIP)
 3. Pin 48 — Logic Common
- d. Install the interface cable and connect the remote control lines to the desired control source. The function of each line is described below:
 1. **START** — If the REMOTE switch in the data logger's SCAN CONTROL switch group is depressed, a contact closure to Logic Common or a low TTL/DTL logic level will initiate a scan sequence. If a scan is in progress, the Start input is ignored.
 2. **SIP** — A TTL output that goes low to indicate that a scan is in progress. Start inputs during this period are ignored. SIP also goes low when REMOTE is pressed, and will remain low until an external START is received and the first scan sequence is completed.
 3. **LOGIC COMMON** — Logic common for the Start input and the SIP output signals.

NOTE

If a single remote control source is used and more than one Digital Output PCB is installed, it is sufficient to complete the remote control connections on only one interface cable.

614-15. OPERATION

614-16. Once installed in the data logger, the Digital Output PCB requires no operator attention. Instructions for connecting the remote control lines are given earlier under the installation. Refer to the appropriate Kennedy Instruction Manual for details concerning the magnetic tape recorder.

614-17. The timing required to initiate a remote start depends upon the data logger's configuration and its current activities. Assuming that the REMOTE SCAN CONTROL switch is depressed the following conditions will assure a start of scan:

- a. Apply a momentary contact closure to ground (48) or a low logic level to the Start input (31). If SIP (6) is initially low (prior to start input), allow the first scan sequence to complete. SIP will return high at the end of the sequence and will go low for subsequent scan sequences.
- b. While the Scan in Progress output is high (i.e., no keyboard or front panel activity) a negative going Start pulse with a width of ≥ 5 ms will cause a remote start.
- c. Under worst case keyboard activity, a Start pulse ≥ 100 ms is required to ensure a remote start.
- d. If the Start input is held low from the start to finish of a scan sequence, a second scan will be initiated. A continuous scan mode is achieved by holding the Start input low.

614-18. THEORY OF OPERATION

614-19. The Digital Output PCB, as shown in Figure 614-4, is a microprocessor based subsystem which functions as a Controller peripheral to provide the interface necessary to transfer data logger time-of-day, digital data, heading and measurement data (as printed on the internal printer) to an external digital recording device. Any one of several types of recorders can be accommodated by the interface. Among these are: a 20 mA current-loop teleprinter, a paper tape punch, an incremental magnetic tape recorder, or any RS-232C compatible recording device. Once the recorder is defined the interface pcb can be tailored to meet the interface requirements by the addition of two plug-in ROM's and an interface cable (both are supplied as an integral part of the option). Additional formatting and baud rate requirements (when applicable) are manually selected using a series of 24 switches located on the pcb. (See Installation instructions for switch settings as they apply

to this option.) Provisions are also included which allow a contact closure to ground (or any other low-level input) to serve as a remote start-of-scan signal to the data logger. While a scan is in progress (SIP) an SIP output is generated to indicate that subsequent start inputs will not be accepted until the current scan sequence has been completed.

614-20. Data transfer from the Controller to the external recorder is accomplished in two operations: first, an input transfer sequence, and then, an output transfer sequence. The input transfer sequence is executed under the direction of the Controller and includes the character-serial transfer of 16 four-bit characters from the Controller (via the Data Bus) to a storage location (RAM) on the Digital Output PCB. After the input transfer is complete, the microprocessor on the Digital Output PCB directs the execution of the output transfer sequence. That is, the transfer of data from the storage location to the recording device. Appropriate handshaking is employed to ensure the output transfer is synchronized with the recorder.

614-21. When the Controller is ready to initiate a data transfer it interrogates the status of the Digital Output PCB by placing a binary coded 6 onto Control Bus A. A decoder on the PCB detects the 6 and initiates an appropriate status response via the Data Bus. Table 614-3 lists the possible responses and their meanings.

614-22. Upon receiving a binary coded 3 (11) as a status response, the Controller initiates the data transfer sequence by simultaneously placing a binary coded 4 onto Control Bus A, and the first data character (4 bits) onto the Data Bus. A Control Bus Decoder detects the control character (binary coded 4) and responds by generating an Interrupt to the MPU and an input Enable to the 4-bit Input Register. On the rising edge of the accompanying Out Strobe the Test input to the MPU is driven high and the character on the Data Bus is entered into the Input Register. As a result of the high Interrupt and Test inputs, the MPU issues a low Interrupt Acknowledge output which is used to provide a Busy response. (Busy is used in the event the status of the output pcb is interrogated prior to completing the entire data transfer to the peripheral device see Table 614-3.) At the same time the MPU causes the output RAM to place a binary coded 8 onto the Output Bus. The presence of this code plus a subsequent IS pulse (generated by the Memory Interface) enables the contents of the Input Register to be read (via the I/O Bus) by the Memory Interface. On the trailing edge of the IS pulse the MPU's Test input is returned low to complete the first character segment of the 16-character input-transfer sequence.

Table 614-3. Description of Status Response Codes

Status Response		Meaning of Status Response
DB1	DB0	
0	0	Remote Start commanded but transfer in progress. Wait until not Busy.
0	1	Remote Start. Initiate a scan sequence.
1	0	Busy. Data transfer in progress. No action required.
1	1	Initiate a data transfer sequence.

614-23. Since the binary coded 4 is still present on the Control Bus, the character-serial transfer of data between the Controller and the Memory Interface continues, as previously described, until an entire block of 16 characters has been processed. As each character of input data is read by the System Interface it is also transferred through the MPU (via the MPU Data Bus) into the RAM.

614-24. After the Controller presents the last input character to the Digital Output PCB it removes the binary coded 4 from Control Bus A. With the control code gone the Interrupt input to the MPU goes low to inhibit additional data from being entered into the input register. This completes the initial phase (input data transfer) of the data transfer sequence.

614-25. The output transfer sequence begins as the MPU writes a binary coded 0 onto the Output Bus. A decoder detects the zero and issues an Enable input to the Recorder Status Logic. If the external device is ready to receive data, the Recorder Status Logic will provide a low Ready output which drives the MPU's test input high to indicate that an output transfer may commence. Since the Digital Output PCB is capable of transferring output data in a bit-serial-by-character format, as well as, a bit-parallel-by-character format, each process will be considered separately.

614-26. Bit parallel output data is stored, one character at a time, in a pair of 4-bit output registers. Data transfer to the registers is enabled by the PM input from the Memory Interface, and is entered on the leading edge of the OS pulse. As PM goes low the first output character, including 4-bits of supplementary data (ASCII, BCDIC, and/or EBCDIC), is placed onto address lines A0 through A7. After the character is entered by the subsequent OS pulse, the PM output is returned high. This PM transition arms the Write/Punch Logic to allow the rising edge of the next Sync pulse to initiate a Write/Punch output pulse. An appropriate amount of time later a second OS pulse is

issued, and the write/punch output is terminated on the trailing edge of the next Sync pulse. As each bit-parallel character appears on the output lines (D0 through D7) a Parity Generator provides a ninth bit (jumper selectable odd or even) for parity.

614-27. The bit serial output is enabled when the MPU instructs the RAM to place a binary coded 11 onto the Output Bus. Output data is then taken a bit at a time from the MPU's CY output and used to drive an EIA output buffer as well as relay K1. The mercury-wetted contacts of K1 are used to provide a current loop interface (contact closure for a 20 mA current loop).

614-28. The format of output data is established by the setting of 24 rocker switches which comprise a 3 x 8 switch matrix (see Figure 614-4). These switches are scanned at the beginning of each output transfer sequence by the MPU (via the RAM Output Bus) and read into the Memory Interface as six 4-bit characters. To read each character the MPU causes the RAM to sequentially place binary coded numbers 0 through 5 onto the Output Bus. A 1-of-10 decoder detects each number, and effectively scans the matrix switches in groups of four. Thus, each closed switch within a scanned group causes a low level to be placed onto the normally high I/O Bus. (Isolation diodes are provided with each switch to avoid interaction between the various groups of matrix switches). As each four-bit word appears on the I/O Bus, it is read into the Memory Interface (by an IS pulse).

614-29. The transfer of output data, regardless of format, must be synchronized with the interfaced recorder. This is accomplished by the Recorder Status Logic which detects and reacts to a series of handshaking routines. For example, Ready and Punch inputs/outputs are used to synchronize the operation to a paper tape punch. Similarly, RS-232C compatible recorders employ the Data-Set-Ready and Clear-to-Send inputs. Magnetic tape recorders utilize the Ready and Write lines to record data, and the EOR (end-of-record) and Gap-in-Progress lines to initiate (EOR) a standard inter-record gap, and to indicate its duration (Gap-in-Progress).

614-30. The Remote Start Logic, upon receipt of an external start command, alters the Digital Output PCB's status response so as to initiate a data logger scan sequence (see Table 614-3). An acceptable start input is a ≥ 5 ms contact closure to ground while the scan-in-progress output is high. When the Controller interrogates the status of the Digital Output PCB (binary coded 6 on Control Bus A) the Remote Start Logic provides a start scan response via the Control Bus Decoder. During the following data transfer sequence the Controller includes both a start-of-scan (binary coded 8) and an end-of-scan (binary coded 9) character with the normal data transfer characters. These two

characters are decoded by the 1-of-10 decoder, and used to initiate and terminate the Scan-in-Progress (SIP) output. While the SIP output is active all start inputs are ignored.

614-31. MAINTENANCE

614-32. Access Information

614-33. Refer to the installation instructions given earlier in paragraph 614-11 for Digital Output PCB access information. Remove the rear-panel output connector before attempting to remove the pcb from the data logger.

614-34. Performance Test

614-35. The Digital Output PCB Assembly is most easily tested under normal operating conditions. That is,

installed in a functional data logger and interfaced with the recording device it normally drives. Output data format and characters can then be checked by comparing data recorded on the internal printer with hard copy data derived from the external recording device.

614-36. LIST OF REPLACEABLE PARTS

614-37. The lists of replaceable parts for the 14 Series of data logger options are given in Tables 614-4, -5, and -6. Refer to Section 5 of the data logger manual for ordering information.



CAUTION

Indicated devices are subject to damage by static discharge.

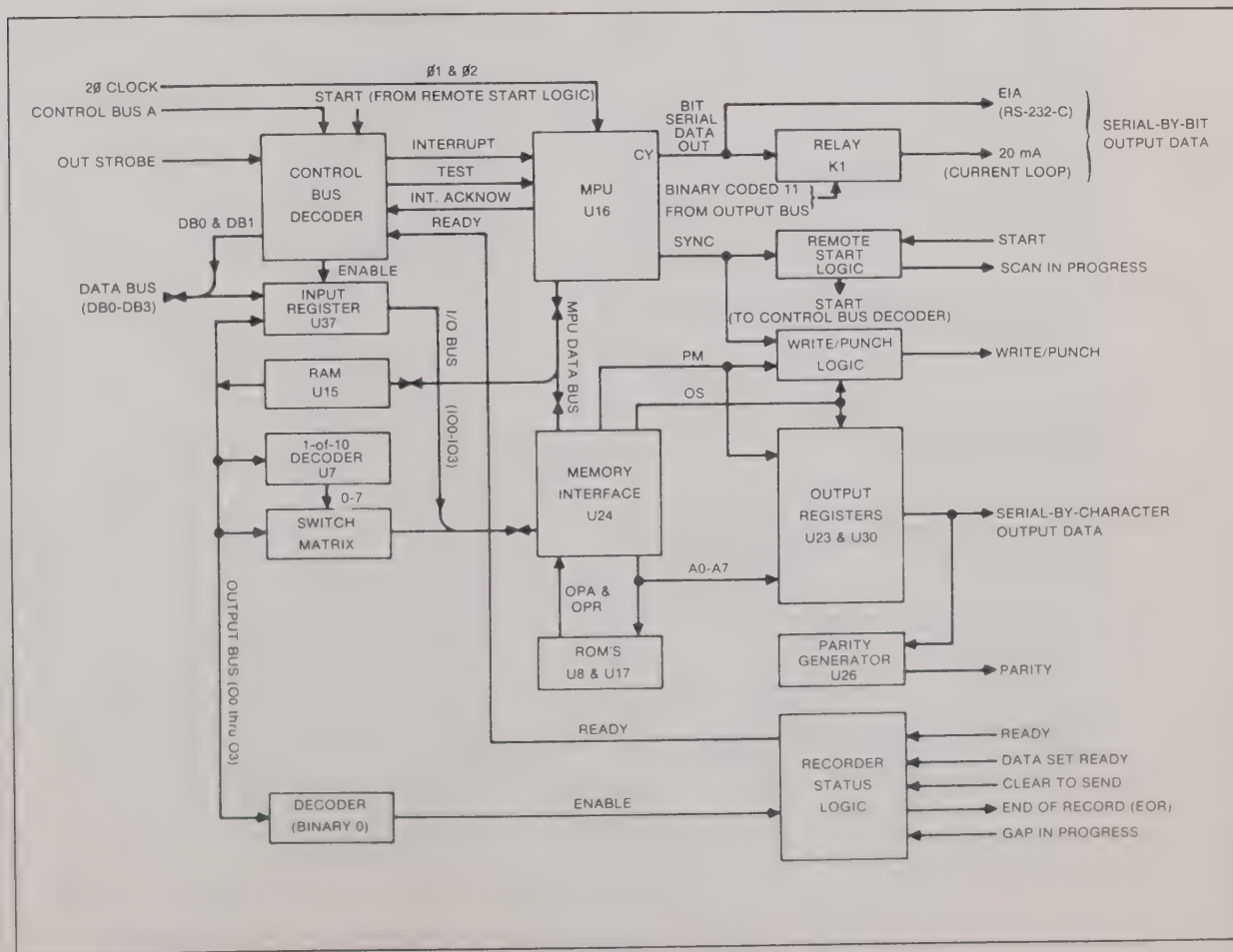


Figure 614-4. Digital Output PCB Simplified Block Diagram

Table 614-4. Final Assembly, -14 Series Options

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	FINAL ASSEMBLY, -14 SERIES OPTIONS						
14A	KENNEDY 1600/5 AND INTERFACE 1, 2, 3, 4, 5, 13, 15 				1		
14B	KENNEDY 1610/5 AND INTERFACE 1, 2, 3, 4, 6, 13, 15 				1		
-14C	KENNEDY 1600/360 AND INTERFACE 1, 2, 3, 4, 7, 13, 15 				1		
-14D	KENNEDY 1610/360 AND INTERFACE 1, 2, 3, 4, 8, 13, 15 				1		
-14E	KENNEDY 1600/5 or 1610/5 INTERFACE 1, 2, 3, 4, 13, 15 				1		
-14G	KENNEDY 1600/360 or 1610/360 INTERFACE 1, 2, 3, 4, 13, 15 				1		
-14H	KENNEDY 9832-7 AND INTERFACE 1, 3, 4, 9, 11, 14, 15 				1		
-14I	KENNEDY 9832-7 INTERFACE 1, 3, 4, 11, 14, 15 				1		
-14J	KENNEDY 9832-9 AND INTERFACE 1, 3, 4, 10, 12, 14, 15 				1		
-14K	KENNEDY 9832-9 INTERFACE 1, 3, 4, 12, 14, 15 				1		

Table 614-4. Final Assembly, -14 Series Options (cont)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	Subassembly item numbers. Descriptions are as follows:						
1	Digital Output PCB Assembly. See Table 614-5	409524	89536	409524	1		
2	Magnetic Tape Interface Cable Assembly. See Table 614-6	377556	89536	377556	1		
3	IC, PROM, special program, U8 and U17 (Provide interface description and U number when ordering replacement.)	432757	89536	432757	2		
4	Jumper, plug-in (10 pack)	373316	89536	373316	1		
5	Tape Recorder, Kennedy 1600/5	435479	89536	435479	1		
6	Tape Recorder, Kennedy 1610/5	435487	89536	435487	1		
7	Tape Recorder, Kennedy 1600/360	435495	89536	435495	1		
8	Tape Recorder, Kennedy 1610/360	431296	89536	431296	1		
9	Tape Recorder, Kennedy 9832-7	461764	89536	413464	1		
10	Tape Recorder, Kennedy 9832-9	413468	89536	413468	1		
11	Magnetic Tape Interface Cable Assembly. See Table 614-6.	471367	89536	471367	1		
12	Magnetic Tape Interface Cable Assembly; See Table 614-6.	471359	89536	471359	1		
13	IC, TTL, hex buffer/driver with open collector (U31 and U33)	328021	01295	SN7417N	2		
14	IC, TTL, Hex inverter/buffer (U31 and U33)	288605	01295	SN7416N	2		
15	Res, comp, 1k $\pm$ 5%, 1/4 W (R10 or R11)	148023	01121	CB1025	1		

Table 614-5. Digital Output PCB Assembly

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	DIGITAL OUTPUT PCB ASSEMBLY, (2200A-4014) Figure 614-5	409524	89536	409524	REF		
C1	Cap, mica, 400 pF $\pm 1\%$, 500V	385328	72136	DM15F401F	1		
C2, C3	Cap, cer, 300 pF $\pm 10\%$, 500V	105734	71590	BB60301KW7W	2		
C4	Cap, Ta, 10 μ F $\pm 20\%$, 20V	330662	56289	196D106X0020- KA1	1		
C5	Cap, cer, 0.68 μ F $-20/+80\%$, 25V	179077	56289	5C023684D8250- B3	1		
CR1, CR3, thru CR28	Diode, Si, switching	203323	07910	1N4448	27	6	
J18	Connector, female, 50 pin	414417	00779	552130-1	1		
K1	Relay, reed	357509	71707	UF-40066	1		
Q1	Xstr, Si, NPN	218396	04713	2N3904	1	1	
R1	Res, comp, 100k $\pm 5\%$, 1/4W	148189	01121	CB1045	1		
R2, R13, R20, R24, R25, R27	Res, comp, 10k $\pm 5\%$, 1/4W	148106	01121	CB1035	6		
R3, R4, R26	Res, comp, 13k $\pm 5\%$, 1/4W	221598	01121	CB1335	3		
R5 thru R9, R12, R14, R16 thru R19	Res, comp, 1k $\pm 5\%$, 1/4W	148023	01121	CB1025	11		
R15	Res, comp, 200 $\pm 5\%$, 1/4W	193482	01121	CB2015	1		
R21	Res, comp, 5.1k $\pm 5\%$, 1/4W	193342	01121	CB5125	1		
R23	Res, comp, 3.3k $\pm 5\%$, 1/4W	148056	01121	CB3325	1		
U1	IC, CMOS, hex buffer 	407759	12040	MM80C97N	1	1	
U2	Res, network	376962	89536	376962	1	1	
U4, U5, U6	Switch Assembly, DIL, 8-position, spdt	414490	00779	435166-5	3	1	

Table 614-5. Digital Output PCB Assembly (cont)

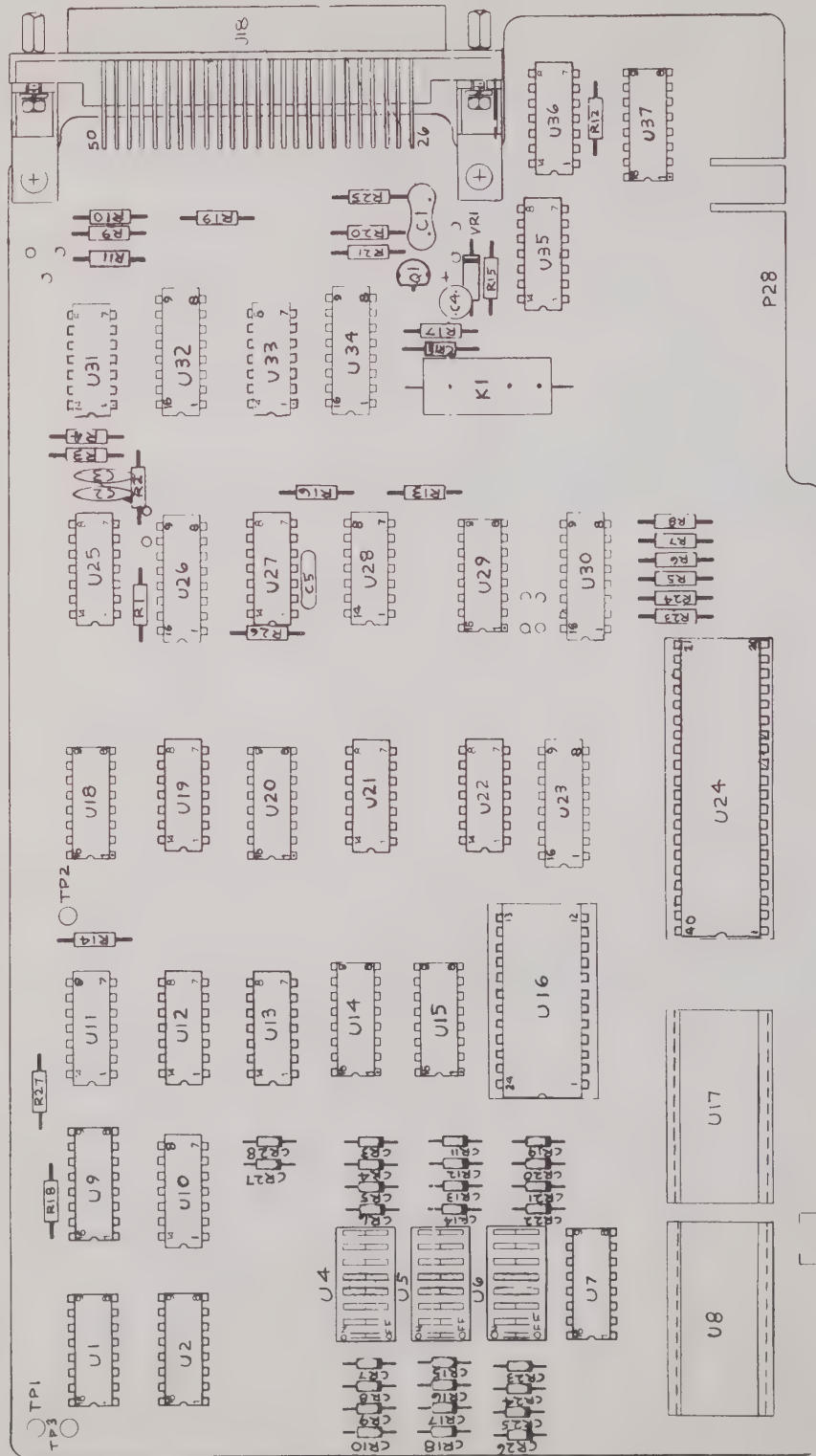
REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U7	IC, CMOS, bcd-to-decimal decoder (X)	407981	12040	MM74C42N	1	1	
U9	IC, CMOS, dual J-K flip flop (X)	355230	04713	MC14027CP	1	1	
U10, U28	IC, CMOS, quad 2-input NAND gate (X)	355198	04713	MC14011CP	2	1	
U11, U22, U25	IC, CMOS, dual D-type flip flop (X)	340117	04713	MC14013CL	3	1	
U12	IC, CMOS, quad 2-input NOR gate (X)	355172	04713	MC14001CP	1	1	
U13	IC, CMOS, dual 4-input NOR gate (X)	363820	04713	MC14002CP	1	1	
U14, U20, U29	IC, CMOS, hex buffer/converter (X)	355214	04713	MC14009CP	3	1	
U15	IC, PMOS, 320 bit RAM and 4-bit output port (X)	404442	34649	P4002-1	1	1	
U16	IC, MOS, central processor (X)	404418	34649	C4040	1	1	
U18	IC, CMOS, hex buffer/converter (X)	355412	04713	MC14010CP	1	1	
U19	IC, CMOS, triple 3-input NAND gate (X)	375147	04713	MC14023CP	1	1	
U21	IC, CMOS, dual 4-input NAND gate (X)	355206	04713	MC14012CP	1	1	
U23, U30	IC, TTL, tri-state, quad D-type flip flop	408203	12040	DM85L51N	2	1	
U24	IC, CMOS, standard memory interface (X)	404434	34649	P4289	1	1	
U26	IC, CMOS, 12-bit parity tree (X)	414060	04713	MC14531CP	1	1	
U27	IC, quad line receiver	414045	12040	LM1489	1	1	
U32	Res, network	358119	89536	358119	1	1	
U34	Res, network	417469	89536	417469	1	1	
U35	IC, TTL, quad 2-input NOR buffer, open collectors	414037	01295	SN74LS33N	1	1	
U36	IC, quad line driver	414052	12040	LM1488	1	1	
U37	IC, CMOS, quad D-type latch (X)	412742	12040	MM74C173N	1	1	

Table 614-5. Digital Output PCB Assembly (cont)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
VR1	Diode, zener	340695	12969	UZ8710	1	1	
	Hardware Kit, connector	435750	00779	552565-1	1		
	Socket, IC, 24-pin DIL	418970	91506	324-AG39D	3		
	Socket, IC, 40-pin DIL	418988	91506	340-AG39D	1		
	Socket, 1 pin	376418	22526	75060-007	11		
	Socket, IC, 14 pin DIL	276527	91507	314-AG39D	2		

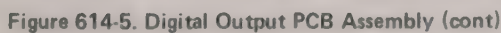
Table 614-6. Interface Cable Assembly

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
2	MAGNETIC TAPE INTERFACE CABLE ASSEMBLY (2200A-4404) Figure 614-6	377556	89536	377556	REF		
P1	Connector with hood	158451	71785	57-30360	1		
P18	Connector, 50 pin	417386	00779	552390-1	1		
	Hood, P18, strain relief	386649	00779	552008-1	1		
11	MAGNETIC TAPE INTERFACE CABLE ASSEMBLY (2200A-4411) Figure 614-7	471367	89536	471367	REF		
P1	Connector	235093	71785	DC37-P	1		
P18	Hood, strain relief	386755	71785	DC51214-1	1		
P18	Connector, 50-pin	417386	00779	552390-1	1		
	Hood, strain relief	386649	00779	552009-1	1		
	Grommet, rubber	100065	83330	2174	2		
	ID, Cable, P18	428870	89536	428870	1		
	ID, Cable, P1	453112	89536	453112	1		
12	MAGNETIC TAPE INTERFACE CABLE ASSEMBLY (2200A-4412) Figure 614-8				REF		
P1	Connector	235093	71785	DC37-P	1		
	Hood, strain relief	386755	71785	DC51214-1	1		
P18	Connector, 50-pin	417386	00779	552390-1	1		
	Hood, strain relief	386649	00779	552008-1	1		
	Grommet, rubber	100065	83330	2174	2		
	ID, Cable, P18	428870	89536	428870	1		
	ID, Cable, P1	473009	89536	473009	1		

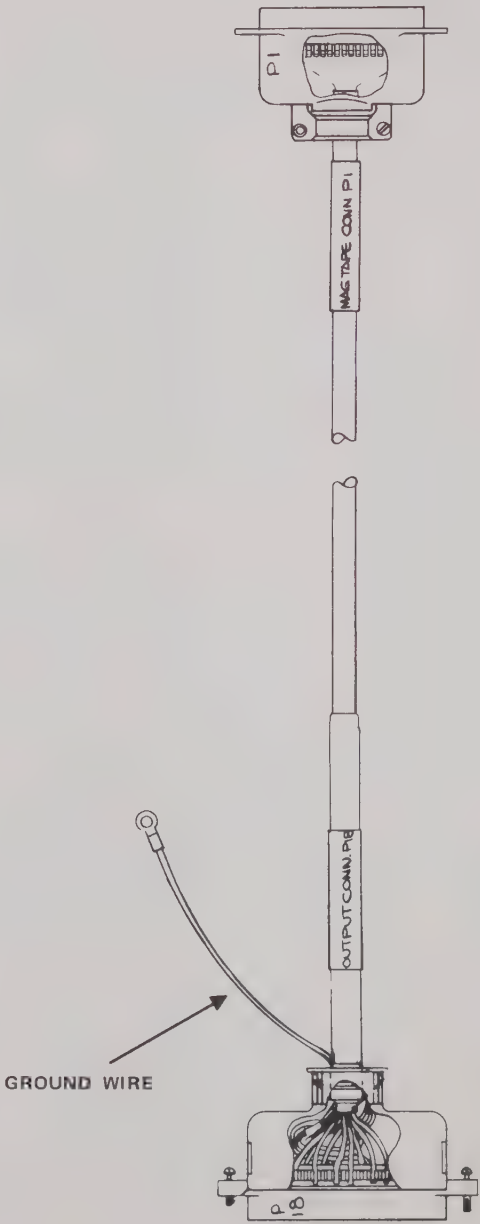


2200A-1614

Figure 614-5. Digital Output PCB Assembly



WIRE LIST	
FROM	TO
P18-1	
-2	P1-29
-3	P1-1
-4	P1-3
-5	
-6	3
-7	
-8	
-9	
-10	
-11	
-12	
-13	P1-18
-14	P1-20
-15	P1-16
-16	P1-22
-17	
-18	
-19	P1-27
-20	P1-14
-21	P1-30
-22	P1-6&7
-23	
-24	
-25	
-26	
-27	P1-8&11
-28	P1-10
-29	
-30	
-31	3
-32	
-33	
-34	
-35	
-36	P1-28
-37	
-38	P1-19
-39	P1-17
-40	P1-21
-41	P1-23
-42	
-43	
-44	
-45	
-46	P1-13
-47	
-48	3
-49	
P18-50	



3 Common ground wire connections.

Figure 614-6. Magnetic Tape Interface Cable Assembly

WIRE LIST	
FROM	TO
P1B-1	
-2	P1-18
-3	
-4	
-5	
-6	3
-7	
-8	
-9	
-10	
-11	
-12	
-13	P1-17
-14	P1-14
-15	P1-12
-16	
-17	
-18	
-19	P1-4
-20	P1-6
-21	P1-7
-22	P1-5
-23	5
-24	
-25	
-26	
-27	
-28	
-29	
-30	
-31	3
-32	
-33	
-34	
-35	
-36	
-37	
-38	P1-16
-39	P1-15
-40	P1-13
-41	
-42	
-43	
-44	
-45	
-46	P1-10
-47	
-48	3
-49	
P1B-50	

3 COMMON GROUND WIRE CONNECTION

5 P1-20 thru P1-37

GROUND WIRE

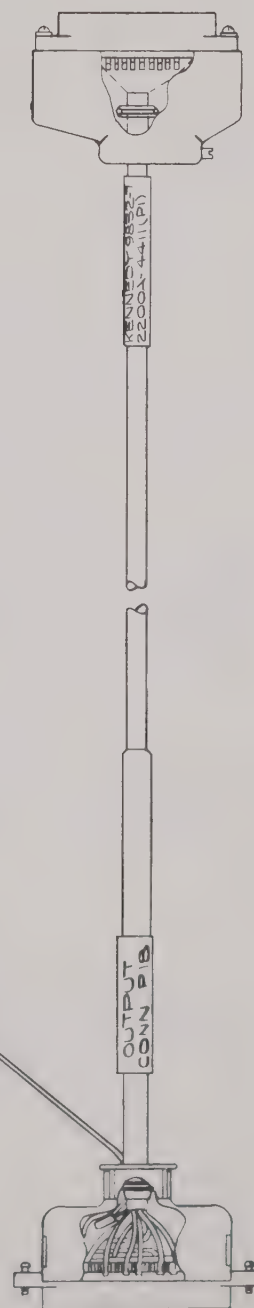


Figure 614-7. Magnetic Tape Interface Cable Assembly

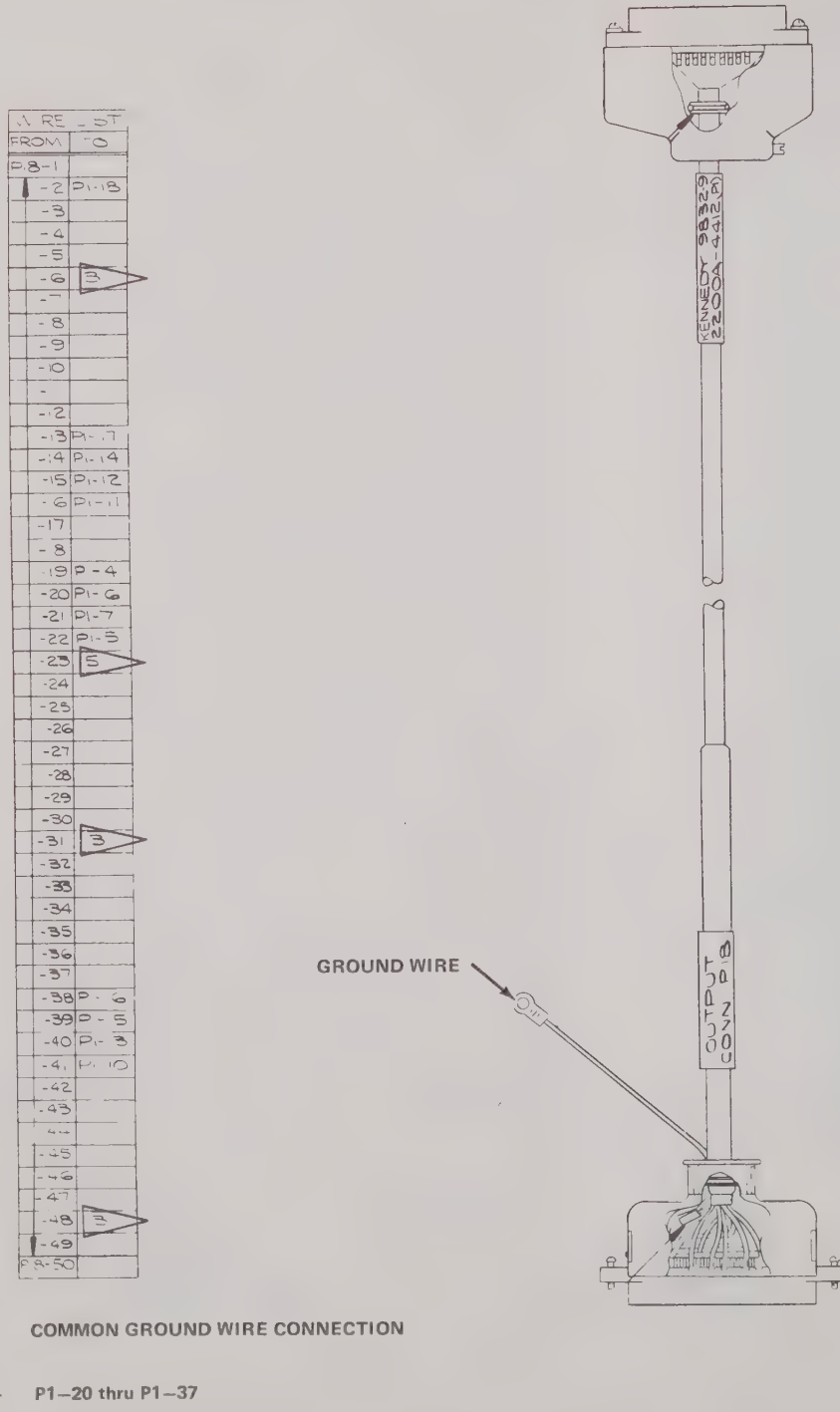


Figure 614-8. Magnetic Tape Interface Cable Assembly

Option -15 IEEE Interface

615-1. INTRODUCTION

615-2. The IEEE Interface (Option 2240B-15) is a plug-in pcb designed to provide the interface necessary to transfer programs and output data to and from devices on the IEEE-488 Bus (IEEE Standard 488, Digital Interface for Programmable instrumentation, hereafter referred to as IEEE-488) and a Model 2240B, 2241B, 2242B Data Logger. The option, along with an IEEE-488 Bus Interface Cable (not provided with this option), provides the required interface between the formentioned data logger and IEEE-488 Bus controller, such as the Fluke Model 1720A. The card is field installable using procedures given later under Installation.

615-3. Operation of the IEEE Interface can be functionally divided into two sequences; Talk and Listen. The Listen function transfers program information from the IEEE-488 Bus to the A3 controller pcb assembly in the data logger, and the Talk function transfers output data (scan and measurement data) from the data logger to the IEEE-488 Bus.

615-4. The IEEE Interface PCB consists of a single plug-in pcb card which can be installed in any one of the three data logger I/O slots. Access to the IEEE-488 Bus is accomplished by a back panel cable and connector. Once the pcb is installed, the Data Logger IEEE-488 Bus address and mode of operation can be set without removing the card from the data logger.

NOTE

2240B-15 and the 2240B-17 Options (Remote Programming Interface cannot be installed in the data logger at the same time.

615-5. SHIPPING INFORMATION

615-6. Upon receipt of the IEEE Interface PCB, check carefully for shipping damage. If the PCB is damaged,

contact the shipping carrier representative for inspection and request an inspection report. Before returning the pcb to the factory contact the local Fluke Customer Service Center.

615-7. If reshipment is necessary and the original container is not available, a new one can be obtained by writing the John Fluke Mfg. Co., Inc. Please reference the instrument model number, part, and part number when requesting a new shipping container.

615-8. INSTALLATION

615-9. The IEEE Interface PCB can be installed in any one of the data logger I/O slots shown in Figure 615-1. To install the pcb in a data logger, use the following procedure:

WARNING

REMOVE LINE POWER AND ALL OTHER HIGH VOLTAGE INPUTS TO THE DATA LOGGER BEFORE STARTING THIS PROCEDURE.

1. Set the data logger POWER switch to OFF.
2. Remove the top cover from the data logger.
3. Locate switch S2 on the pcb as shown in Figure 616-1. S2 is used to assign the IEEE-488 Bus address code to the pcb.
4. With reference to Table 615-1, set positions 1 through 5 of S2 to assign the desired address character.
5. Locate Switch S1 on the pcb as shown on Figure 615-1.

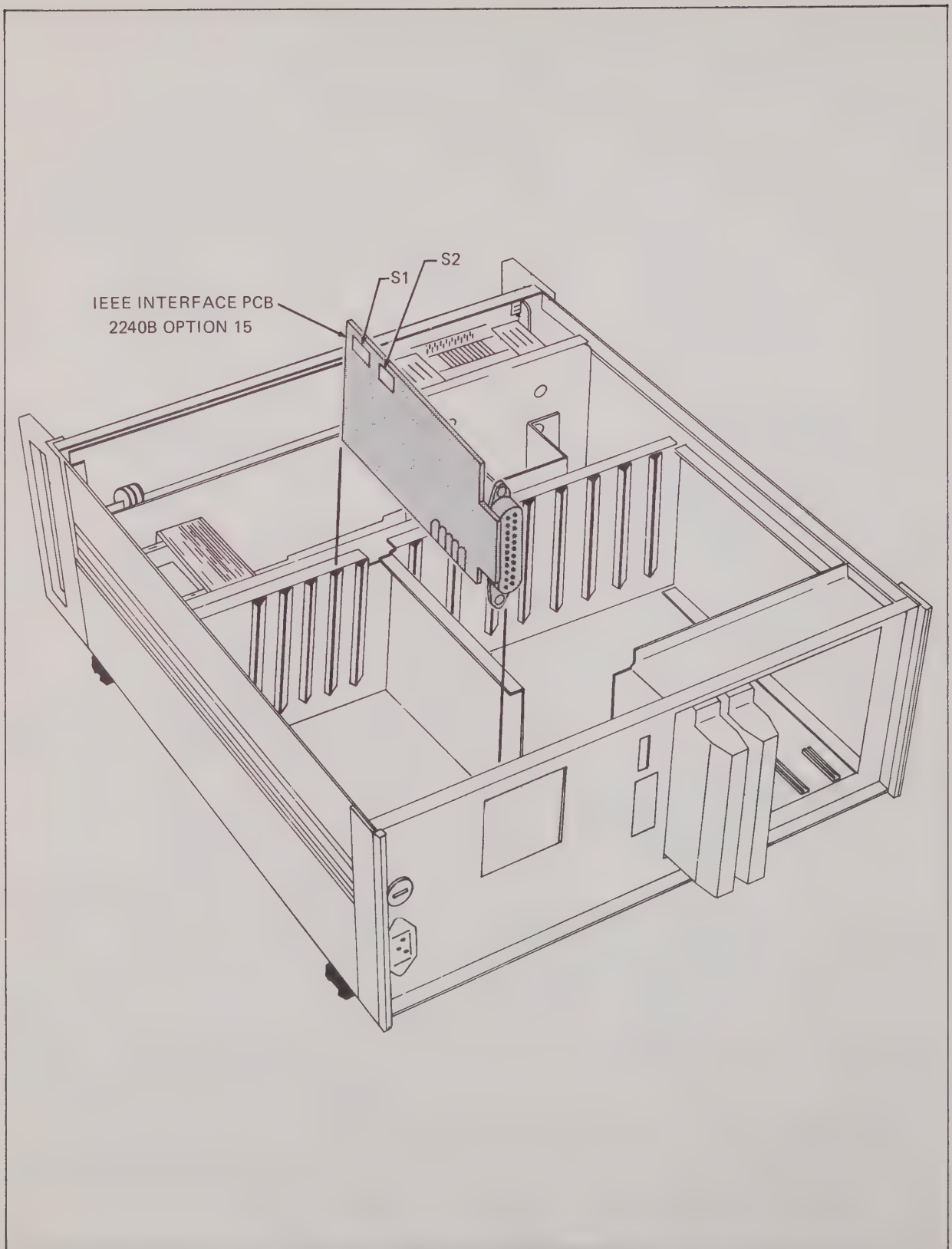


Figure 615-1. Installation and Switch Locations

Table 615-1. Switch S2, IEEE-488 Bus Address Selection

Talk Address = 1 0 X X X X X				S2 Switch Setting = X X X X X				
Listen Address = 0 1 X X X X X				Switch ON = 1				
				OFF = 0				
ADDRESS CODES		ADDRESS CHARACTERS		ADDRESS SWITCH SETTINGS				
DECIMAL	OCTAL	LISTEN	TALK	(5)	(4)	(3)	(2)	(1)
0	0	SP	@	0	0	0	0	0
1	1	!	A	0	0	0	0	1
2	2	"	B	0	0	0	1	0
3	3	#	C	0	0	0	1	1
4	4	\$	D	0	0	1	0	0
5	5	%	E	0	0	1	0	1
6	6	&	F	0	0	1	1	0
7	7	'	G	0	0	1	1	1
8	10	(	H	0	1	0	0	0
9	11	)	I	0	1	0	0	1
10	12	*	J	0	1	0	1	0
11	13	+	K	0	1	0	1	1
12	14	,	L	0	1	1	0	0
13	15	—	M	0	1	1	0	1
14	16	.	N	0	1	1	1	0
15	17	/	O	0	1	1	1	1
16	20	0	P	1	0	0	0	0
17	21	1	Q	1	0	0	0	1
18	22	2	R	1	0	0	1	0
19	23	3	S	1	0	0	1	1
20	24	4	T	1	0	1	0	0
21	25	5	U	1	0	1	0	1
22	26	6	V	1	0	1	1	0
23	27	7	W	1	0	1	1	1
24	30	8	X	1	1	0	0	0
25	31	9	Y	1	1	0	0	1
26	32	:	Z	1	1	0	1	0
27	33	;	[	1	1	0	1	1
28	34	<	\	1	1	1	0	0
29	35	=	]	1	1	1	0	1
30	36	>	^	1	1	1	1	0

6. Refer to Table 615-2, and set positions 1 through 4 of S1 to define the configuration of the pcb.

7. Align the IEEE Interface PCB in the selected I/O slot, so that the female connector is toward the rear of the data logger, and the small board-edge connector is toward the bottom of the unit. Push the pcb straight down and into the mating connector.

8. After the pcb is installed, install the top cover.

615-10. IEEE-488 BUS INTERFACE CABLE

615-11. The IEEE Interface PCB is connected to devices on the IEEE-488 Bus by means of the IEEE-488 Bus Interface cable. The cable conforms to IEEE-488 Bus

standards and can be ordered in three different lengths: 1 meter (Y8001), 2 meters (Y8002), and 4 meters (Y8003).

615-12. OPERATING NOTES

615-13. The following paragraphs describe various conditions that should be considered before attempting to operate the IEEE Interface PCB.

615-14. IEEE-488 Bus

615-15. IEEE-488 Bus is an interfacing arrangement suited for programmable measurement instrumentation systems. Sixteen bus transmission lines provide for all data and message transfer and control. Bus lines are defined under the following three categories:

Table 615-2. Switch S1, Configuration/Interface Selection

SWITCH SLIDE	FUNCTION	ON	OFF
1	Talker Only Mode (ton)	Talker Only	Not enabled
2	Analog readings per line	4 RPL	1 RPL
3	SRQ Enable	Enabled	Not enabled
4	Not implemented	-----	-----
5	Not connected	-----	-----

1. Eight data bus lines (DI01-DI08) data or address information will be carried on these lines in bit-parallel, byte-serial format. Information transfer on these lines is asynchronous and bidirectional.

2. Three handshake lines:

- a. DAV (Data Valid): Indicates to a receiver that data is available on the DIO lines.
- b. NRFD (Not Ready For Data): Indicates whether all devices are ready to accept data.
- c. NDAC (Not Data Accepted): Indicates the acceptance of data by all devices.

3. Five bus management lines:

- a. ATN (Attention): When true (low), DI01-DI08 will carry addresses or commands; when false DI01-DI08 carry data.

- b. IFC (Interface Clear): When true, (low) enables the following states:

Talker idle
Serial Poll idle
Listener idle

- c. SRQ (Service Request): Operates as described by SRQ switch operation (Configuration/Interface Switch (S1) Operation: SRQ, (S1-3).

- d. REN (Remote Enable): Not used in the 2240B-15.

- e. EOI (End or Identify): Set true (low) when the last byte of data is present on the IEEE-488 Bus.

615-16. A maximum of 15 devices may be interconnected on one contiguous bus structure. These devices may perform any combination of the following functions: talk, listen, or control. Figure 615-2 illustrates typical connections on the IEEE-488 Bus. Table 615-3 defines remote message coding used on the Bus.

615-17. Programming Format

615-18. The IEEE Interface PCB is capable of accepting a series or string of alpha-numeric characters and interpreting them as control/program data. These data command strings when properly formatted, enable the IEEE-488 bus controller to program the following data logger functions:

1. Scan Control
2. Output Control
3. Time
4. Scan Format
5. Channel Programming
6. Limits Programming

615-19. The format of the command string is shown in Table 615-4. It consists of a command character, a numeric data field, and a carriage return terminator. An alphabetic command character defines the function to be programmed (scan control, output control, etc). The commanded function is then programmed by a series of numeric characters. These characters represent a variable length numeric field and may contain a number of delimiters in the form of commas (.). After the numeric field is complete, the command string is both terminated and executed by a carriage return (CR) character.

NOTE

A delimiter cannot be used for concatenation of command strings. Each string must be individually terminated.

615-20. A complete list of command characters and their associated numeric fields are given in Table 615-5. Proper formatting of a typical programming sequence is shown in Table 615-6.

615-21. Output Format

615-22. Output format from the IEEE Interface PCB is recorded at the IEEE-488 talker device in the standard format shown in Table 615-7. A switch (S1-2) on the IEEE Interface PCB allows selection of either one or four measurement data readings per line.

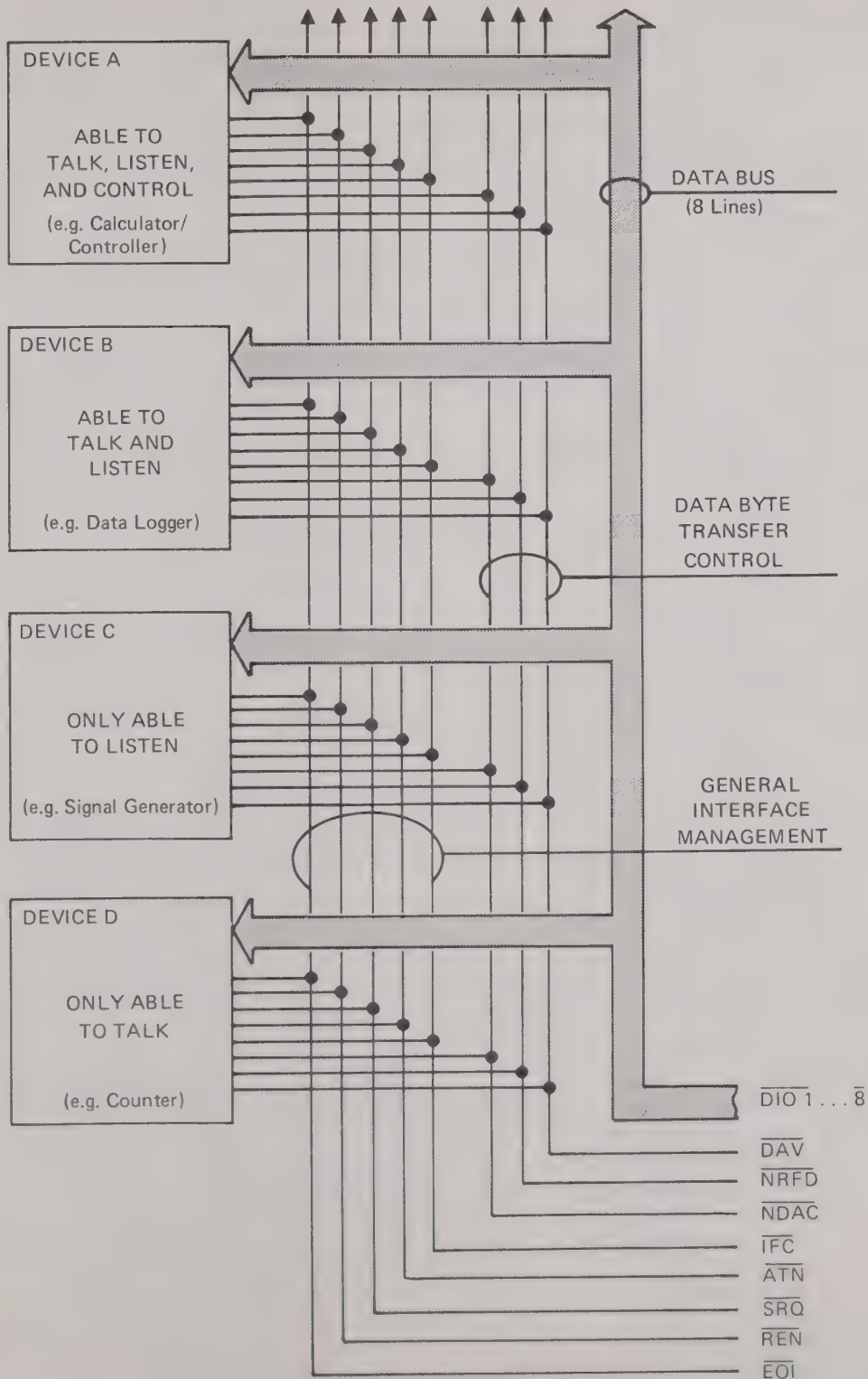


Figure 615-2. IEEE-488 Bus Connections

Table 615-3. Remote Message Coding

MNEMONIC	MESSAGE NAME	BUS SIGNAL LINE(S) AND CODING THAT ASSERT MESSAGE TRUE													MESSAGE TYPE	MESSAGE CLASS	NOTES
		DATA I/O								BUS MANAGEMENT							
		D108	D107	D106	D105	D104	D103	D102	D101	ATN	EOI	SRQ	IFC	REN			
ACG	Addressed Command Group	X	0	0	0	X	X	X	X	1	X	X	X	X	M	AC	1,6,7
ATN	Attention	X	X	X	X	X	X	X	X	1	X	X	X	X	U	UC	
DAB	Data Byte	D8	D7	D6	D5	D4	D3	D2	D1	0	X	X	X	X	M	DD	
DCL	Device Clear	X	0	0	1	0	1	0	0	1	X	X	X	X	M	UC	7
END	End	X	X	X	X	X	X	X	X	0	1	X	X	X	U	ST	
EOS	End of String	E8	E7	E6	E5	E4	E3	E2	E1	0	X	X	X	X	M	DD	2,7
GET	Group Execute Trigger	X	0	0	0	1	0	0	0	1	X	X	X	X	M	AC	3 4 5 7
GTL	Go To Local	X	0	0	0	0	0	0	1	1	X	X	X	X	M	AC	
IDY	Identify	X	X	X	X	X	X	X	X	1	1	X	X	X	U	UC	
IFC	Interface Clear	X	X	X	X	X	X	X	X	X	X	X	1	X	U	UC	
LAG	Listen Address Group	X	0	1	X	X	X	X	X	1	X	X	X	X	M	AD	
LLO	Local Lock Out	X	0	0	1	0	0	0	1	1	X	X	X	X	M	UC	
MLA	My Listen Address	X	0	1	L5	L4	L3	L2	L1	1	X	X	X	X	M	AD	
MTA	My Talk Address	X	1	0	T5	T4	T3	T2	T1	1	X	X	X	X	M	AD	
MSA	My Secondary Address	X	1	1	S5	S4	S3	S2	S1	1	X	X	X	X	M	SE	
NUL	Null Byte	0	0	0	0	0	0	0	0	0	X	X	X	X	M	DD	
OSA	Other Secondary Address	(OSA = SCG • MSA)													M	SE	
OTA	Other Talk Address	(OTA = TAG • MTA)													M	AD	
PCG	Primary Command Group	(PCG = ACG + UCG + LAG + TAG)													M	—	
REN	Remote Enable	X	X	X	X	X	X	X	X	X	X	X	X	1	U	UC	7
RQS	Request Service	X	1	X	X	X	X	X	X	0	X	X	X	X	U	ST	
SCG	Secondary Command Group	X	1	1	X	X	X	X	X	1	X	X	X	X	M	SE	
SDC	Selected Device Clear	X	0	0	0	0	1	0	0	1	X	X	X	X	M	AC	6,7
SPD	Serial Poll Disable	X	0	0	1	1	0	0	1	1	X	X	X	X	M	UC	
SPE	Serial Poll Enable	X	0	0	1	1	0	0	0	1	X	X	X	X	M	UC	
SRQ	Service Request	X	X	X	X	X	X	X	X	X	X	1	X	X	U	ST	
STB	Status Byte	S8	X	S6	S5	S4	S3	S2	S1	0	X	X	X	X	M	ST	
TCT	Take Control	X	0	0	0	1	0	0	1	1	X	X	X	X	M	AC	
TAG	Talk Address Group	X	1	0	X	X	X	X	X	1	X	X	X	X	M	AD	
UCG	Universal Command Group	X	0	0	1	X	X	X	X	1	X	X	X	X	M	UC	
UNL	Unlisten	X	0	1	1	1	1	1	1	1	X	X	X	X	M	AD	
UNT	Untalk	X	1	0	1	1	1	1	1	1	X	X	X	X	M	AD	

SYMBOLS

Type U = Uniline Message
 M = Multiline Message

Class AC = Address Command
 AD = Address (Talk or Listen)
 DD = Device Dependent
 HS = Handshake
 UC = Universal Command
 SE = Secondary
 ST = Status

0 = Logical Zero (HIGH Signal Level)
 1 = Logical One (LOW Signal Level)
 X = Don't Care or Not Driven

NOTES

- (1) D1-D8 specify the device dependent data bits
- (2) E1-E8 specify the device dependent code used to indicate EOS message
- (3) L1-L5 specify the device dependent bits of the device's listen address
- (4) T1-T5 specify the device dependent bits of the device's talk address
- (5) S1-S5 specify the device dependent bits of the device's secondary address
- (6) S1-S6, S8 specify the device dependent status. (D107 is used for the RQS message)
- (7) The true message value must be ignored when received the LACS is inactive

Table 615-5. Definition of Command and Response Codes (cont)

CODE	FORMAT	SCAN FORMAT
F	FXXX	Sets first channel to XXX (000-999)
L	LYYY	Sets last channel to YYY (000-999)
M	MZZZ	Sets Monitor channel to ZZZ (000-999)
H	HXXX- XXX	Sets fixed data to XXXXXX (000000-999999)
I	IXX.YY .ZZ	Sets the interval to XX Hrs. YY Min. ZZ Sec.
T	TWWW. .XX.YY. ZZ	Sets Time of Year to WWW Days XX Hrs YY Min. ZZ Sec
SECOND INTERVAL		
G	GXXX	Sets first channel to XXX (000-999)
K	KYYY	Sets last channel to YYY (000-999)
J	JXX.YY	Sets second interval time to XX Hrs (00-99) and YY Min (00-99)
*All commands must be entered in fixed field format, i.e., channel 23 → 023, Day 2 → 002.		
ERROR MESSAGES		
ERR01	Data Logger not in remote	
ERR02	Command string over 16 characters	
ERR03	Not a valid command	
ERR04	Memory Error	
	A) individual programming mode, channel number >255	
	B) memory not available for channels above 127	
	C) limits memory option not installed	
ERR05	A-D Function error	
	Random access channel programming	
	A) Function is not available	
	B) Temperature option not installed	
ERR06	Remote Command is not enabled	

Table 615-6. Typical Programming Sequence (cont)

COMMAND STRING	COMMENTS
C002,0,00,00 CR	Skip Channel 2
C003,4,33,16 CR	Channel 3, 4V, Limit 16
V01,3,2000 CR	Limit 1 = HI +2000
V16,1,1000 CR	Limit 16 = LO +1000
W4 CR	Output, All Data
S4 CR	Continuous scan starts on CR

615-22. Configuration/Interface Switch (S1) Operation**615-23. SRQ (Service Request)**

615-24. When SRQ is enabled (Switch S1-3 = ON) the IEEE Interface PCB requests service from the IEEE-488 Bus controller when it contains a complete "data logger" reading. Service is requested by asserting the SRQ bus management line low. The SRQ line is released by the IEEE Interface PCB when the first data byte is transferred onto the IEEE-488 Bus from the output buffer. The IEEE Interface responds to a serial poll interrogation by a controller on the IEEE-488 Bus. The serial poll response can be a 41 hex code (ASCII "A") if the IEEE Interface has initiated the service request, or a D hex code (ASCII "null") if it had not. If the IEEE Interface has initiated an SRQ and the current reading has not been entirely read (through the terminating CR/LF characters) all data logger scanning stops. Scanning resumes when the complete current reading has been completely read.

615-25. When SRQ is not enabled (S1-3 = OFF), the IEEE Interface PCB continuously updates its output with the current reading until addressed as a talker. When addressed as a talker, the current reading is being held and the data logger stops scanning until the full reading has been taken or a untalk signal to the IEEE Interface PCB has been sent and acknowledged.

615-27. TON (Talker Only)

615-28. When ton is enabled, (Switch S1-1 = ON) the IEEE Interface PCB automatically enters the Talker Addressed State (TADS). To use this function, three switches must be set. The LOCAL/REMOTE switch (S1) located on the A3 Controller must be set to LOCAL, and the SCAN control and OUTPUT control must be selected on the 2240B front panel (See Section 2 of the 2240B Instruction Manual).

Table 615-6. Typical Programming Sequence

COMMAND STRING	COMMENTS
T123,23,50,31CR	Time of Year
F000 CR	First Channel = 0
L003 CR	Last Channel = 3
M001 CR	Monitor Channel = 1
C000,1,00,00 CR	Channel 0, 400 mV, Skip Limits
C001,6,01,16 CR	Channel 1, T1, Limits 1 & 16

Table 615-7. Standard Output Format

Table 6-15-7. Standard Output Format																					
DESCRIPTION	OUTPUT DATA*																				
Time of Year	<u>Y</u>	<u>DC</u>	<u>DC</u>	<u>DC</u>	:	<u>H</u>	<u>H</u>	:	<u>M</u>	<u>M</u>	:	<u>S</u>	<u>S</u>	<u>CR</u>	<u>LF</u>						
Fixed Data	<u>X</u>	<u>FD</u>	<u>FD</u>	<u>FD</u>	<u>FD</u>	<u>FD</u>	<u>CR</u>	<u>LF</u>													
Digital Input Data	<u>D</u>	<u>AC</u>	<u>AC</u>	<u>SP</u>	<u>DD</u>	<u>DD</u>	<u>DD</u>	<u>DD</u>	<u>DD</u>	<u>DD</u>	<u>DD</u>	<u>DD</u>	<u>DD</u>	<u>CR</u>	<u>FL</u>						
(Option -16)							SP	9	9	9	9	9	*	*	O	L					
							SP	7	7	7	7	7	*	*	B	T					
Measurement Data													SP	C	SP	SP					
																	SP	F	SP	SP	
																	M	V	SP	SP	
Data Column ID (For Reference Purposes only- Not Recorded)	<u>A</u>	<u>CH</u>	<u>CH</u>	<u>CH</u>	<u>SP</u>	<u>±</u>	<u>AD</u>	<u>AD</u>	<u>AD</u>	<u>.</u>	<u>AD</u>	<u>AD</u>	<u>SP</u>	<u>V</u>	<u>SP</u>	<u>SP</u>	<u>CR</u>	<u>LF</u>			
	<u>0</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>	<u>17</u>			
*MNEMONICS A = Measurement Data ID AC = Address Code AD = Analog Data CH = Channel No CR = Carriage Return D = Digital Input ID DC = Day Code DD = Digital Input Data FD = Fixed Data H = Hours LF = Line Feed M = Minutes S = Seconds SP = Space X = Fixed Data ID Y = Time of Year ID **OL = Overload **BT = Broken Bhermocouple C = Degrees Celsius F = Degrees Fahrenheit MV = Millivolts V = Volts																					

615-29. Analog Readings Per Line

615-30. When Switch S1-2 is enabled (ON), a CR/LF character is opened to every fourth analog reading output to the IEEE-488 Bus. The 1st, 2nd, and 3rd analog readings are followed by two spaces.

615-31. OPERATION

615-32. Once installed, the IEEE Interface PCB requires no operator attention other than ensuring that normal turn-on procedures are observed for both the data logger and devices on the IEEE-488 Bus. Select the remote mode of operation either manually or remotely as required by the position of switch S1 on the data logger A3 Controller PCB (See Section 2, Figure 2-6 of the 2240B Instruction Manual). Follow the programming format given earlier to control the operation of the data logger. Each of the remote programming functions

correspond to the manual functions described in Section 2 of the 2240B Instruction Manual.

615-33. THEORY OF OPERATION

615-34. The IEEE Interface PCB, as shown in Figure 615-3 is a microprocessor based subsystem which functions as an A3 Controller peripheral to provide the interface necessary to transfer data logger program and output data to and from devices on the IEEE-488 Bus. Once devices on the IEEE-488 Bus have been defined, the IEEE Interface PCB is tailored to meet the interface requirements by setting a series of switches on the pcb. (See Installation instructions for switch settings as they apply to this option). These settings are read by the MPU (Microprocessor Unit) and stored in the memory PROMS (Programmable Read Only Memories) U21 and U11 via the memory interface (U6) each time the data logger is turned on.

615-35. Operation of the IEEE Interface PCB can be functionally divided into two sequences; Listen and Talk. The Listen function involves the transfer of program information from the IEEE-488 Bus to the A3 controller in the data logger. The Talk function involves the transfer of output data (scan and measurement data) from the data logger to the IEEE-488 Bus. For both cases, each I/O word up to 16 characters) is temporarily stored on the IEEE-488 Interface PCB to synchronize its transfer operations with either the A3 Controller PCB or devices on the IEEE-488 Bus as required.

615-36. Listen Function

615-37. Bit-parallel, byte-serial program data from the IEEE-488 Bus is received by the pcb through IEEE-488 compatible transceivers to the GPIA (General Purpose Interface Adapter) U3. When a character byte is received, the GPIA generates an Interrupt Request (IRQ) low (0.0V) output, (IRQ is connected to the INT input on the MPU.) In response to an Interrupt (INT) low input, the MPU reads the 8-bit GPIA data in character byte via GPI/O U2 and the MPU Data Bus. Data characters received by the MPU, are transferred to, and stored in RAM 0 (Random Access Memory). When a complete command (up to 16 characters) has been assembled, the MPU checks it for errors, and formats it for use by the data logger's A3 controller PCB. Then RAM 0 initiates IRQ to notify the A3 Controller PCB that data is ready to be processed.

615-38. In response to the IRQ, the A3 Controller PCB begins to poll the various I/O pcb's to determine which pcb requested the interrupt, and what service, if any, is required. To poll the IEEE Interface PCB, the A3 Controller places a binary coded 6 onto Control Bus A (CA0-CA3). The pcb detects its code and responds with its current status via the System Data Bus. The possible response codes and their meanings are shown in Table 615-8. When the IEEE Interface PCB has initiated an interrupt request (IRQ), it confirms the action by placing a binary coded 7 on the System Data bus as a response code.

Table 617-8. IEEE Interface PCB Response Codes

BINARY CODED STATUS RESPONSE	DEFINITION
6	Interrupt Request and Busy
7	Interrupt Request (IRQ)
14	Busy
15	Not Busy, No Interrupt

615-39. When the A3 Controller PCB is ready to receive data from the IEEE Interface PCB, it places a binary coded 14 onto Control Bus A. The code is detected by the Control Bus Decoders which in turn, enables data from port Y of the GPI/O (U23) to be placed onto the System Data Bus. The decoded transmit code (Binary 14) is latched onto port W of the GPI/O with every Sync pulse. Concurrently, the MPU, on every Sync pulse, reads port D of the GPI/O (U23). When it detects a data request code (Binary 14), it proceeds to transfer 16 characters to the A3 controller via port Y of the GPI/O. At the end of the transfer, the Controller terminates the sequence by removing the binary coded 14 from the Control Bus.

615-40. Talk Function

615-41. When the A3 Controller PCB is ready to put data onto the IEEE-488 Bus, it polls the status of the IEEE Interface PCB by placing a binary coded 6 on Control Bus A. If the PCB is not busy it responds with a binary 15 via the System Data Bus and thereby prompts the controller to output data onto the IEEE-488 Bus. The controller places a binary coded 4 onto Control Bus A. This code is latched into port W of the GPI/O (U23) for later reference by the MPU. Subsequent data characters that appear on the System Data Bus are serially loaded into the FIFO (First-In First-Out) and held until accessed by the MPU. When accessed by the MPU, the 16 data characters are serially loaded into port X of the GPI/O (U23) by pulse Z1. All 16 characters are transferred and stored in RAM 0 for further processing. Processed data is transferred to RAM 1 and 3 to await output to the IEEE-488 Bus. During the remainder of the sequence, the MPU checks the content and format of the received data. Before transfer to the IEEE-488 Bus occurs, the MPU polls the status of the GPIA and IEEE-488 Bus Control lines. If the IEEE Interface PCB is addressed as a talker, NRFD (Not Ready For Data) is false (high) and the data out register of the GPIA is empty. The MPU also checks to see if SRQ is to be sent out. Data is then sent to the data out register of the GPIA for output on the IEEE-488 Bus.

615-42. Each character is transformed into an ASCII seven-level character by the MPU before being presented to the GPIA via ports W and X of the GPI/O (U23). Port Y is used to address the appropriate register in the GPIA. Each character is entered into the GPIA data out register by strobe Z0. The data is then sent to listeners on the IEEE-488 Bus via the handshake process.

615-43. MAINTENANCE

615-44. Access Information

615-45. Refer to the installation instructions given earlier in this subsection for IEEE Interface PCB access information. Remove the rear panel output connector before attempting to remove the pcb from the data logger.

615-46. Performance Test

615-47. The IEEE Interface PCB is most easily tested under normal operating conditions; i.e., installed in a functional data logger and interface with a IEEE-488 Bus controller. Output data can then be checked by comparing data recorded on the internal printer with hard copy data derived from the external recording device. Similarly, the effects of remote programming can be compared with manual programming to isolate malfunctions to the pcb level.

615-48. If a malfunction has been isolated to the IEEE Interface PCB, replace same and send the malfunctioning pcb back to the manufacturer (see Shipping Information).

615-49. LIST OF REPLACEABLE PARTS

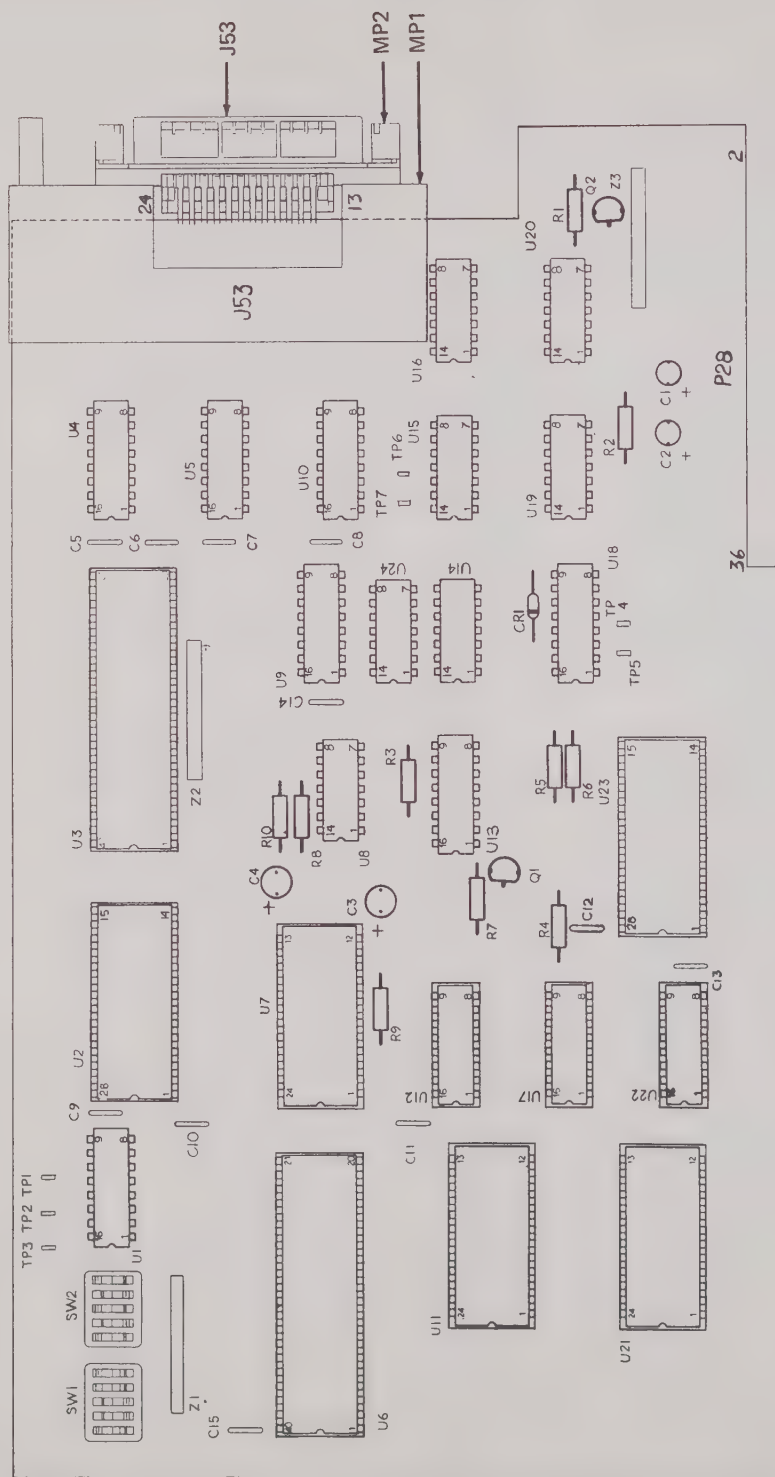
615-50. The lists of replaceable parts for the -15 Option are given in Table 615-9. Refer to Section 5 of the data logger manual for ordering information.

Table 615-9. IEEE Interface PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NO TE
	⊗IEEE INTERFACE PCB ASSEMBLY, OPTION -15 FIGURE 615-4 (2240B-4015T)	526657	89536	526657	1		
C1	CAP, TA, 10 UF, +/-20%, 20V	330662	56289	196D106X0020KA1	2		
C2	CAP, TA, 10 UF, +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C3	CAP, TA, 1 UF +/-20%, 35V	161919	56289	196D105X0020JA1	2		
C4	CAP, TA, 1 UF +/-20%, 35V	161919	56289	196D105X0020JA1	REF		
C5	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	11		
C6	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	REF		
C7	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	REF		
C8	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	REF		
C9	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	REF		
C10	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	REF		
C11	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	REF		
C12	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	REF		
C13	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	REF		
C14	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	REF		
C15	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	REF		
CR1	DIODE, SI, HI-SPEED SWITCHING	203323	09214	1N4448	1		
J53	CONNECTORS, IEEE	484220	89536	484220	1		
MP1	BRACKET	526624	89536	526624	1		
MP2	HARDWARE, CONNECTOR MOUNTING (TO J53)	448563	00779	552565-2	1		
Q1	XSTR, SI, PNP	195974	04713	2N3906	1	1	
Q2	XSTR, SI, NPN	218396	04713	2N3904	1	1	
R1	RES, DEP. CAR, 30K +/-5%, 1/4W	368753	80031	CR251-4-5P30K	4		
R2	RES, DEP. CAR, 30K +/-5%, 1/4W	368753	80031	CR251-4-5P30K	REF		
R3	RES, DEP. CAR, 30K +/-5%, 1/4W	368753	80031	CR251-4-5P30K	REF		
R4	RES, DEP. CAR, 6.2K +/-5%, 1/4W	442368	80031	CR251-4-5P6.2K	5		
R5	RES, DEP. CAR, 6.2K +/-5%, 1/4W	442368	80031	CR251-4-5P6.2K	REF		
R6	RES, DEP. CAR, 6.2K +/-5%, 1/4W	442368	80031	CR251-4-5P6.2K	REF		
R7	RES, DEP. CAR, 6.2K +/-5%, 1/4W	442368	80031	CR251-4-5P6.2K	REF		
R8	RES, DEP. CAR, 6.2K +/-5%, 1/4W	442368	80031	CR251-4-5P6.2K	REF		
R9	RES, DEP. CAR, 30K +/-5%, 1/4W	368753	80031	CR251-4-5P30K	REF		
R10	RES, DEP. CAR, 100K +/-5%, 1/4W	348920	80031	CR251-4-5P100K	1		
S1	SWITCH, DIP	454769	89536	454769	2		
S2	SWITCH, DIP	454769	89536	454769	REF		
TMI	INSTRUCTION MANUAL (2240B OPTION -15)	539148	89536	539148	1		
TP1	CONNECTOR, TEST POINT	512889	89536	512889	7		
TP2	CONNECTOR, TEST POINT	512889	89536	512889	REF		
TP3	CONNECTOR, TEST POINT	512889	89536	512889	REF		
TP4	CONNECTOR, TEST POINT	512889	89536	512889	REF		
TP5	CONNECTOR, TEST POINT	512889	89536	512889	REF		
TP6	CONNECTOR, TEST POINT	512889	89536	512889	REF		
TP7	CONNECTOR, TEST POINT	512889	89536	512889	REF		
U1⊗	IC, C-MOS TRI-STATE HEX NON INVRTNG BUFF	407759	12040	MM80C97N	2	1	

Table 615-9. IEEE Interface PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	N O T E
U2	IC, PROGRAMABLE, GENERAL PURPOSE	453456	34649	P4265	2		
U3②	IC, C-MOS, N-CHANNEL, SILICON GATE	477794	04713	SC80910P/L	1		
U4	IC, QUAD, THREE-STATE BUS TRANSCEIVER	453480	04713	MC3448P	4		1
U5	IC, QUAD, THREE-STATE BUS TRANSCEIVER	453480	04713	MC3448P	REF		
U6	IC, 4-BIT MICROCOMPUTER	404434	34649	P4289CA	1		1
U7	IC, 4-BIT MICROCOMPUTER	404418	34649	C4040	1		1
U8②	IC, C-MOS, HEX INVERTER, 14-PIN DIP	404681	02735	CD4069UBE	3		1
U9	IC, QUAD, THREE-STATE BUS TRANSCEIVER	453480	04713	MC3448P	REF		
U10	IC, QUAD, THREE-STATE BUS TRANSCEIVER	453480	04713	MC3448P	REF		
U11	IC, PROGRAMMABLE	538835	89536	538835	2		
U12	IC, 4-BIT MICROCOMPUTER	404467	34649	P4002-2	1		
U13②	IC, C-MOS, FIFO REGISTER	495200	02735	CD40105BE	1		
U14②	IC, C-MOS, QUAD, 2-INPUT OR GATE	408393	02735	CD4071BE	1		1
U15②	IC, C-MOS, DUAL, 4-INPUT, POS, NAND GATE	355206	04713	MC14012CP	2		1
U16②	IC, C-MOS, HEX INVERTER, 14-PIN DIP	404681	02735	CD4069UBE	REF		
U17	IC, 4-BIT MICROCOMPUTER	404442	34649	P4002-1	2		1
U18②	IC, C-MOS TRI-STATE HEX NON INVRTNG BUFF	407759	12040	MM80C97N	REF		
U19②	IC, C-MOS, DUAL, 4-INPUT, POS, NAND GATE	355206	04713	MC14012CP	REF		
U20②	IC, C-MOS, HEX INVERTER, 14-PIN DIP	404681	02735	CD4069UBE	REF		
U21	IC, PROGRAMMABLE	538835	89536	538835	REF		
U22	IC, 4-BIT MICROCOMPUTER	404442	34649	P4002-1	REF		
U23	IC, PROGRAMABLE, GENERAL PURPOSE	453456	34649	P4265	REF		
U24②	IC, C-MOS, QUAD 2-INPUT AND GATE	408401	02735	CD4081BE	1		
XU2	SOCKET, 28-PIN	448217	89536	448217	2		
XU3	SOCKET, 40-PIN	418988	89536	418988	2		
XU6	SOCKET, 40-PIN	418988	89536	418988	REF		
XU7	SOCKET, 24-PIN	418970	89536	418970	3		
XU11	SOCKET, 24-PIN	418970	89536	418970	REF		
XU12	SOCKET, 16-PIN	276535	89536	276535	3		
XU17	SOCKET, 16-PIN	276535	89536	276535	REF		
XU21	SOCKET, 24-PIN	418970	89536	418970	REF		
XU22	SOCKET, 16-PIN	276535	89536	276535	REF		
XU23	SOCKET, 28-PIN	448217	89536	448217	REF		
Z1	RES, NETWORK, 100K +/-2%, 1/8W	461038	89536	461038	3		
Z2	RES, NETWORK, 100K +/-2%, 1/8W	461038	89536	461038	REF		
Z3	RES, NETWORK, 100K +/-2%, 1/8W	461038	89536	461038	REF		
KIT	RECOMMENDED SPARE PARTS KIT	539817	89536	539817	AR		



2240B-1615

Figure 615-4. IEEE Interface PCB Assembly (cont)

REF DES	+5V	-10V	▽
U1	16	—	2,8
U2	1	28	15
U3	20	—	1,2
U4	4,12,16	—	8
U5	16,4,1	—	8,1,12
U6	20	40	35
U7	9	14,15,21	—
U8	14	—	7,3,13
U9	16,7,12	—	8,9,15,4
U10	16,4,12	—	8
U11	21,24	—	12
U12	5	10,12	—
U13	16	—	8,1
U14	14	—	7,12,13
U15	14	—	7
U16	14	—	7
U17	5,10	12	—
U18	16	—	8
U19	14	—	7
U20	14	—	7,13
U21	21,24	—	12
U22	5	10,12	—
U23	1	28	15
U24	14	—	7

REFERENCE DESIGNATOR	
LAST USED	NOT USED
R10 Z3	
C15 Q2	
C81 TP7	
U24	

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTANCES ARE IN OHMS & ALL CAPACITANCES ARE IN MICROFARADS
2. ALL RESISTORS ARE 5% 1/4W
3. ALL GRAPHIC SYMBOLS ARE IN ACCORDANCE WITH ANSI Y32.2 & Y32.14

2240B-1015

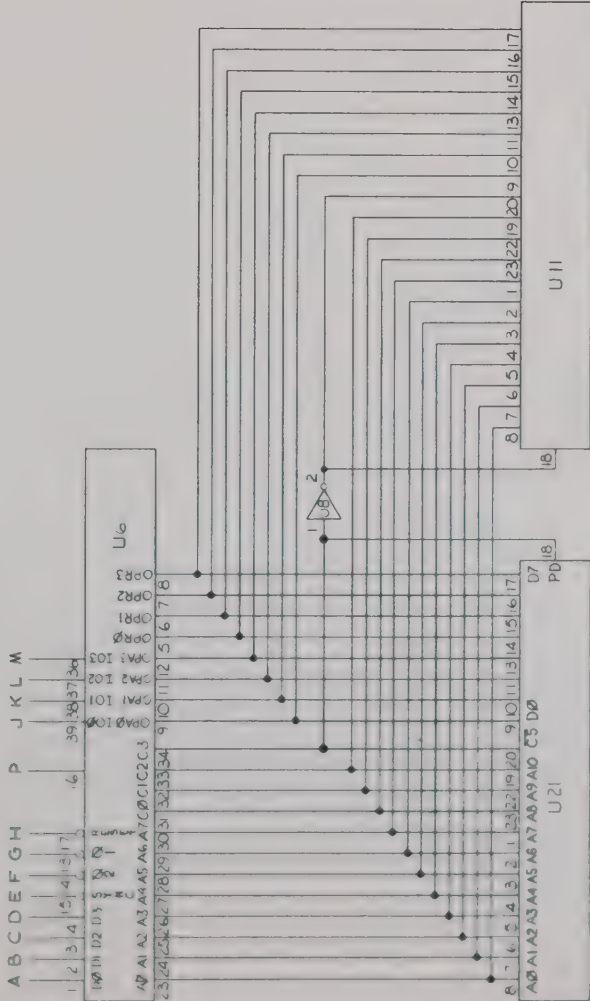


Figure 615-4. IEEE Interface PCB Assembly

Option —16 Digital Input

616-1. INTRODUCTION

616-2. The Digital Input Option (—16) is a plug-in pcb assembly designed to provide the printer and external recording devices with up to nine digits of externally generated digital input data. The data is derived from a remote source in bcd character-parallel format (DTL/TTL, positive-true) and loaded into storage by a remote Load Data pulse. Data cannot be loaded while the recorders are reading input data, and Busy/ $\overline{\text{Busy}}$ output flags are provided to indicate the read period. Read period occurs immediately prior to the first analog data reading.

616-3. The data logger is capable of accommodating up to three Digital Input PCB's. Digital data from the pcb's is read in a sequence determined by the setting of four Address Code Switches located on each pcb. These address codes are assigned by the user so that the first pcb to be read is coded as address 0, the second is coded 1, and the third is coded 2. The physical order in which the pcb's are installed in the data logger does not influence the order in which data is read.

616-4. SPECIFICATIONS

616-5. Specifications for the Digital Input Option (—16) are given in Table 616-1.

Table 616-1. Digital Input Option Specifications

Number of Digits ...	Nine
Input Code	BCD, positive-true
Logic Levels	DTL/TTL
Control Inputs	Load Data, Busy, $\overline{\text{Busy}}$
Record Location	Follows Fixed Data

616-6. INSTALLATION

616-7. Up to three Digital Input PCB's can be mounted in the data logger's I/O slots, as shown in Figure 616-1. Install each pcb as follows:

WARNING

REMOVE LINE POWER AND ALL OTHER HIGH VOLTAGE INPUTS TO THE DATA LOGGER BEFORE STARTING THIS PROCEDURE.

- Set the data logger's POWER switch to OFF.
- Remove the top cover from the data logger.
- Locate the Address Code Switches on each Data Input PCB as shown in Figure 616-1, and assign consecutive address codes (starting with 0) to each pcb by setting the switches to the patterns shown in Table 616-2. When Digital Input Data is recorded address 0 is read first, 1 second, and 2 last.
- Align each Data Input PCB in its selected I/O slot so that the large female connector is toward the rear of the data logger, and the small board-edge connector is toward the bottom of the unit. Push the pcb straight down onto the mating connector.
- After the Digital Input PCB(s) is' (are) installed, install the top cover.

ADDRESS CODE	ADDRESS CODE SWITCH SETTINGS			
	1	2	3	4
0	ON	ON	ON	ON
1	ON	ON	ON	OFF
2	ON	ON	OFF	ON

616-8. OPERATION

616-9. Once installed in the data logger, the Digital Input Option requires no operator attention. However, certain considerations are necessary to properly

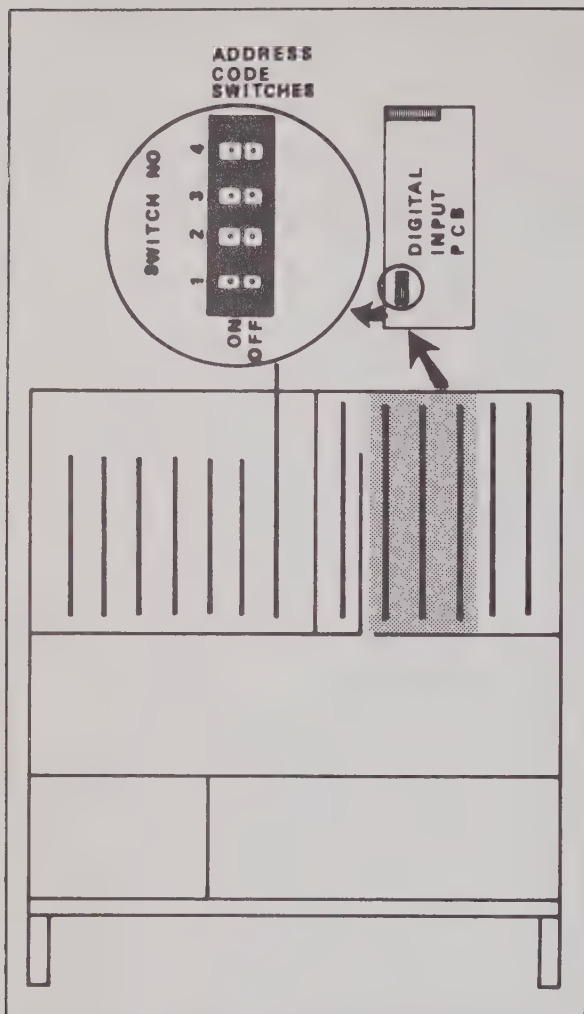


Figure 616-1. Data Input Option, Installation and Switch Locations

interface the option with remote input data. These considerations are covered in the following paragraphs.

616-10. Interface Connections

616-11. Remote interface connections to a Digital Input PCB are completed through a General Purpose Interface Cable (2200A-7006) or a blank Interface Connector (2200A-7007) which attaches to the digital input connector at the rear of the data logger. The cable assembly is supplied as part of the Digital Input Option and the connector is available as an accessory. A description of the Connector is given earlier in this section under accessories.

616-12. The user is responsible for completing the cable connections to the remote data source. The pin assignments for the Digital Input Option rear-panel connector are given in Table 616-3.

Table 616-3. Option —16, I/O Connector (J33) Pin Assignments

PIN	SIGNAL	PIN	SIGNAL
1	N/C	26	LOAD
2	DB0	27	DB3
3	DB1	28	DB2
4	DB2	29	DB1
5	DB3	30	DB0
6	BUSY	31	SIGNAL GND.
7	BUSY	32	SIGNAL GND.
8	DB3	33	DB0
9	DB2	34	DB1
10	DB1	35	DB2
11	DB0	36	DB3
12	N/C	37	+5V dc
13	N/C	38	+5V dc
14	DB3	39	DB0
15	DB2	40	DB1
16	DB1	41	DB2
17	DB0	42	DB3
18	N/C	43	DB0
19	N/C	44	DB1
20	DB3	45	DB2
21	DB2	46	DB3
22	DB1	47	DB3
23	DB0	48	DB2
24	N/C	49	DB1
25	N/C	50	DB0

N/C = No Connection

616-13. I/O Data Requirements

616-14. The I/O requirements necessary to load data into a Digital Input Option PCB are given in Table 616-4. See Table 616-3 for I/O connector pin assignments.

616-14. Ground Loop Considerations

616-15. Data inputs to the Digital Input PCB are not isolated and, therefore, are referenced to the data loggers unguarded +5V dc supply (logic common). To protect both the data logger and the external data source from damage due to ground loops, a fuse is installed on the Digital Input PCB. Fuse replacement details are given later under maintenance.

616-16. THEORY OF OPERATION

616-17. The Digital Input PCB as shown in Figure 616-2 functions as a remote data interface to provide the Controller with up to nine externally-generated digits of input data. Ultimately the Controller presents this data

to the printer as supplemental heading information. The input digits are derived from a user supplied data source and are received at the Digital Input PCB in character-parallel format. An externally generated load pulse enters the parallel digits into a series of storage registers on the pcb. This stored data is then solicited via Control Bus A and read into the Controller via the Data Bus. While the Controller is reading data from the registers, a complementary pair of Busy flags is generated by the Digital Input PCB. These flags indicate the duration of the read period and are intended for use in providing the external data source with legal load-period timing. This is necessary since the storage registers cannot be updated while they are being read by the Controller. All data and control inputs/outputs to the external data source are positive-true DTL/TTL logic levels.

Table 616-4. I/O Data Requirements

Logic Levels	DTL/TTL compatible, positive true.
Input Data Format	Up to nine BCD, character-parallel digits.
Load Pulse	Input Data is loaded by a negative going pulse at the Load input. The pulse duration must be $\geq 50 \mu\text{s}$.
Busy/ <u>Busy</u>	Input data can be loaded any time the <u>Busy</u> pulse is low or the Busy pulse is high.
Unused Digits	The inputs for unused digits may be left open. Data will not be recorded in these positions.
+5V dc Output	A +5V dc output is available to power external circuitry. The total current drain should not exceed 50 mA.

616-18. Operation can be logically divided into two sequences; load and read. Load sequences are initiated by an externally generated Load command and can be executed any time a read sequence is not in progress. Complementary Busy flags are provided to indicate the legal load periods. Read sequences are initiated under the direction of the Controller and include an address verification routine to ensure that the proper output pcb has been addressed. This is necessary since up to three Digital Input PCB's can be installed in a data logger.

616-19. A load sequence is initiated when a low level ($\geq 50 \mu\text{s}$) is applied to the Load input of the Digital Input PCB. If a read sequence is not in progress, the

next Sync pulse from the Controller sets a pair of flip-flops in the control logic. This generates the leading edge of the data load pulse causing all nine digits of external input data to be loaded into a series of parallel input digit latches. On the next Sync pulse the data load pulse is terminated. When the external Load input returns high the control logic is reset, thereby arming the input register for the next load sequence.

616-20. A read sequence is initiated when the Controller places a binary coded 7 onto the Control Bus A and the Digital Input PCB's switch address (0, 1 or 2) onto the Data Bus. When the combination of these inputs are present a compare input is presented to the control logic. On the rising edge of the subsequent Out strobe the control logic accepts the compare input to enable the read sequence. As a result the decade counter is enabled, an In strobe is enabled to serve as the counter's clock and a read (outputs) signal is generated. The combination of the read (outputs) and the count 0 outputs enable a set of four tri-state drivers which place a binary coded zero onto the data bus. The Controller recognizes this code as a valid address reply and responds by generating a series of In strobes. Each strobe advances the decade counter causing each of the nine input digit latches to be sequentially addressed. The Controller reads each new character on the leading edge of the In strobe and advances the decade counter on the strobes trailing edge. After the ninth character has been read the binary coded 7 is removed from Control Bus A. This effectively resets the control logic by clearing the enable and read outputs.

616-21. MAINTENANCE

616-22. Access Information

616-23. Refer to the installation instructions given in paragraph 616-6 for Digital Input Option access information. Remove the rear panel input connector before attempting to remove the pcb from the data logger.

616-24. Fuse Replacement

616-25. A 1/4 amp, fast-acting fuse is located on the component-side of the Digital Input PCB Assembly. If replacement is necessary, pull the old fuse from the fuse clip and press a new one into place.

616-26. Performance Test

616-27. The Digital Input Option is most easily tested under normal operating conditions. That is, installed in a functional data logger, and connected to its input data source (as provided by the user). When any scan sequence is executed and the internal printer is enabled,

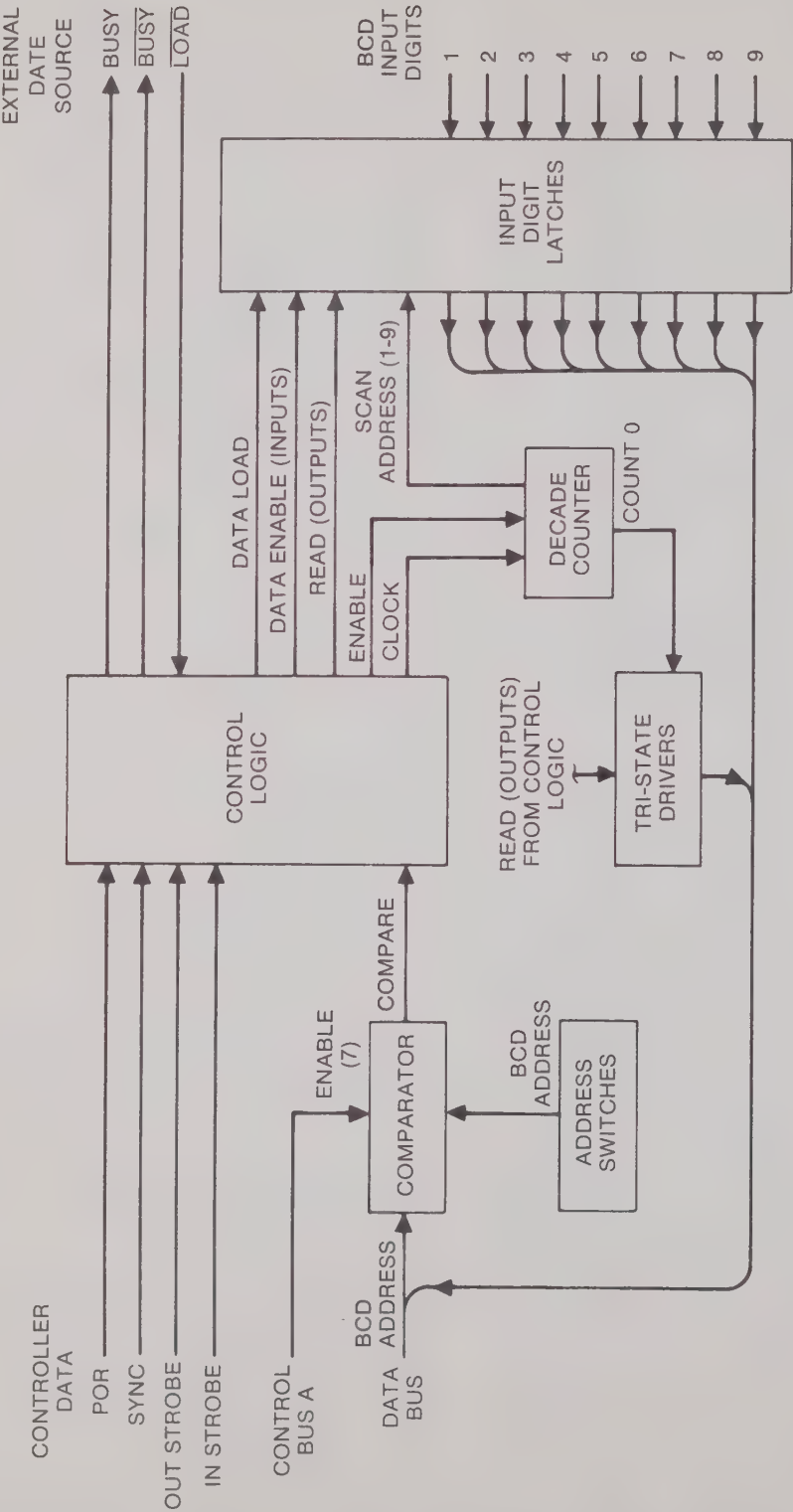


Figure 616-2. Digital Input PCB Simplified Block Diagram

the digital input data from the data source should be printed following the fixed data entry (2240A) or the scan counter entry (2200A). If two or three Digital Input Options PCB's are installed in the same unit, input data will be printed in the order assigned by the address switch settings (see installation instructions). If no data is printed, either the fuse on the pcb is blown, input data is not being loaded correctly, or the board address has not been set correctly. If some, but not all, characters, of entered data are printed incorrectly, the input registers on the Digital Input PCB are probably defective.

616-28. LIST OF REPLACEABLE PARTS

616-29. A list of replaceable parts for the Digital Input Option is given in Table 616-5. Refer to Section 5 of this manual for ordering information.

CAUTION

Indicated devices are subject to damage by static discharge.

Table 616-5. Digital Input Option —16 (Continued)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	MODEL 2200A-16 DIGITAL INPUT OPTION, FINAL ASSEMBLY						
	Digital Input PCB Assembly (2200A-4017)	406397	89536	406397	1		
	General Purpose Interface Cable Assembly (2200A-4405)	373357	89536	373357	1		
	DIGITAL INPUT PCB ASSEMBLY (2200A-4017) Figure 616-3	406397	89536	406397	REF		
C1	Cap, Ta, 10 μ F $\pm$ 20%, 25V	330662	56289	190D106X0020- KA1	1		
F1	Fuse, fast acting, 1/4 Amp	109314	71400	AGC1-4	1	5	
J33	Connector, pcb mounting, 64-pin, female	414417	00779	552130-1	1		
R1 thru R4, R7 thru R10	Res, comp, 10k $\pm$ 5%, 1/4W	148106	01121	CB1035	8		
R5, R6	Res, comp, 100 $\pm$ 5%, 1/4W	147926	01121	CB1015	2		
U1	Switch Assembly	408559	00779	435166-2	1	1	
U2	IC, COS/MOS, quad exclusive-OR gate 	355222	18725	CD4030AE	1	1	
U3, U4, U9, U10, U15, U16, U21, U22, U28	IC, COS/MOS, quad D-type latch 	412742	12040	MM74C173N	9	2	
U5, U11, U17, U23, U29	Res, network, 100k (typical)	380618	89536	380618	5	1	
U6, U12, U18, U24, U30	Res, network, 47k (typical)	381996	89536	381996	5	1	
U7	IC, CMOS, decade counter/divider 	403568	18725	CD4017AE	1	1	
U8, U14, U26, U27	IC, COS/MOS, hex buffer/converter 	355214	04713	MC14009CP	4	1	
U13	IC, CMOS, triple 3-input NAND gate 	375147	04713	MC14023CP	1	1	

Table 616-5. Digital Input Option —16 (Concluded)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U19	IC, COS/MOS, dual J-K flip flop (X)	355230	04713	MC14027CP	1	1	
U20, U33	IC, COS/MOS, quad 2-input NOR gate (X)	355172	04713	MC14001CP	2	1	
U25	IC, CMOS, quad 2-input NAND gate (X)	355198	04713	MC14011CP	1	1	
U31, U36	IC, CMOS, hex non-inverting buffer (X)	407759	12040	MM80C97N	2	1	
U32	IC, CMOS, dual, D-type flip flop (X)	340117	04713	MC14013CL	1	1	
U34	IC, CMOS, dual 4-input NAND gate (X)	355206	04713	MC14012CP	1	1	
U35	IC, COS/MOS, hex buffer/converter (X)	355412	04713	MC14010CP	1	1	
	GENERAL PURPOSE INTERFACE CABLE ASSEMBLY (2200A-4405) Figure 616-4	373357	89536	373357	REF		
P18	Connector, 64-pin, male	266056	13511	57-30500	1		
	Kit, connector hardware (hood and associated hardware)	435750	00779	552565-1	1		

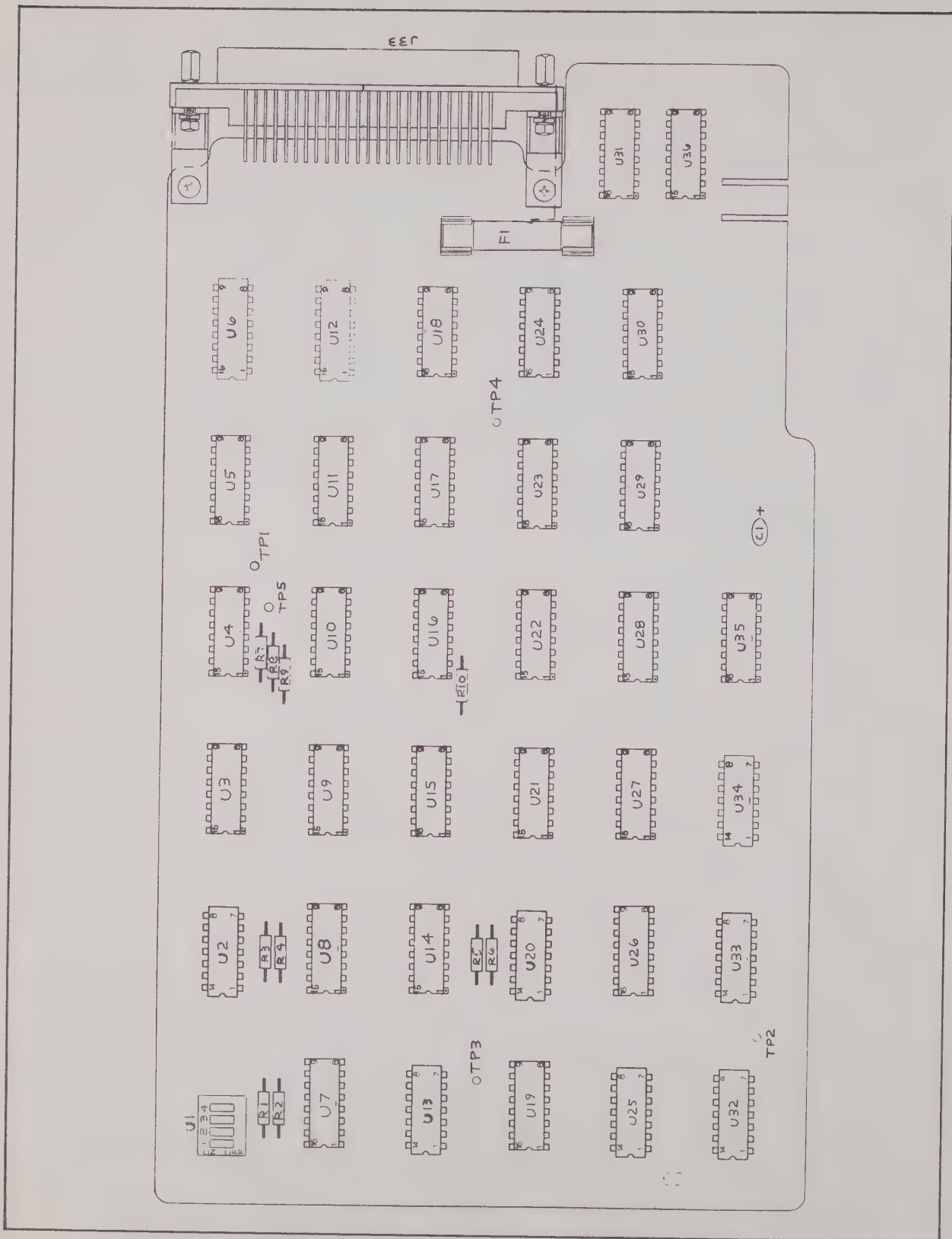


Figure 616-3. Digital Input PCB Assembly Option —16 (2200A-1017) (Sheet 1 of 3)

NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
2. FOR ASSY DWG SEE 220CA-4017
3. ALL RESISTORS ARE 1/4W, 5% UNLESS OTHERWISE NOTED.
4. ALL GRAPHIC SYMBOLS IN ACCORDANCE WITH ANSI Y32.14 AND Y32.2.
5. ▽ DENOTES UNGUARDED LOGIC COMMON (UL COM).

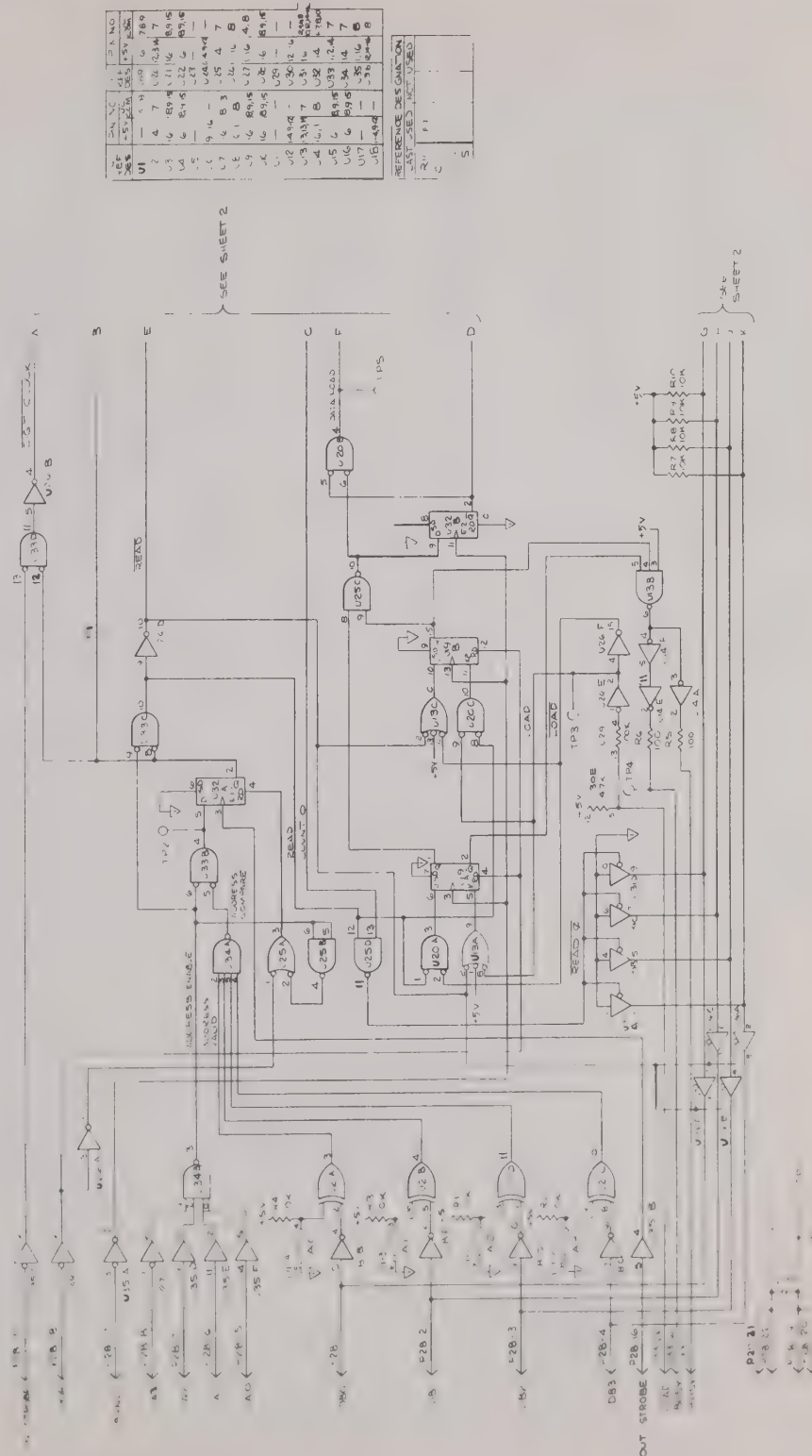


Figure 616-3. Digital Input PCB Assembly Option —16 (2200A-1017) (Sheet 2 of 3)

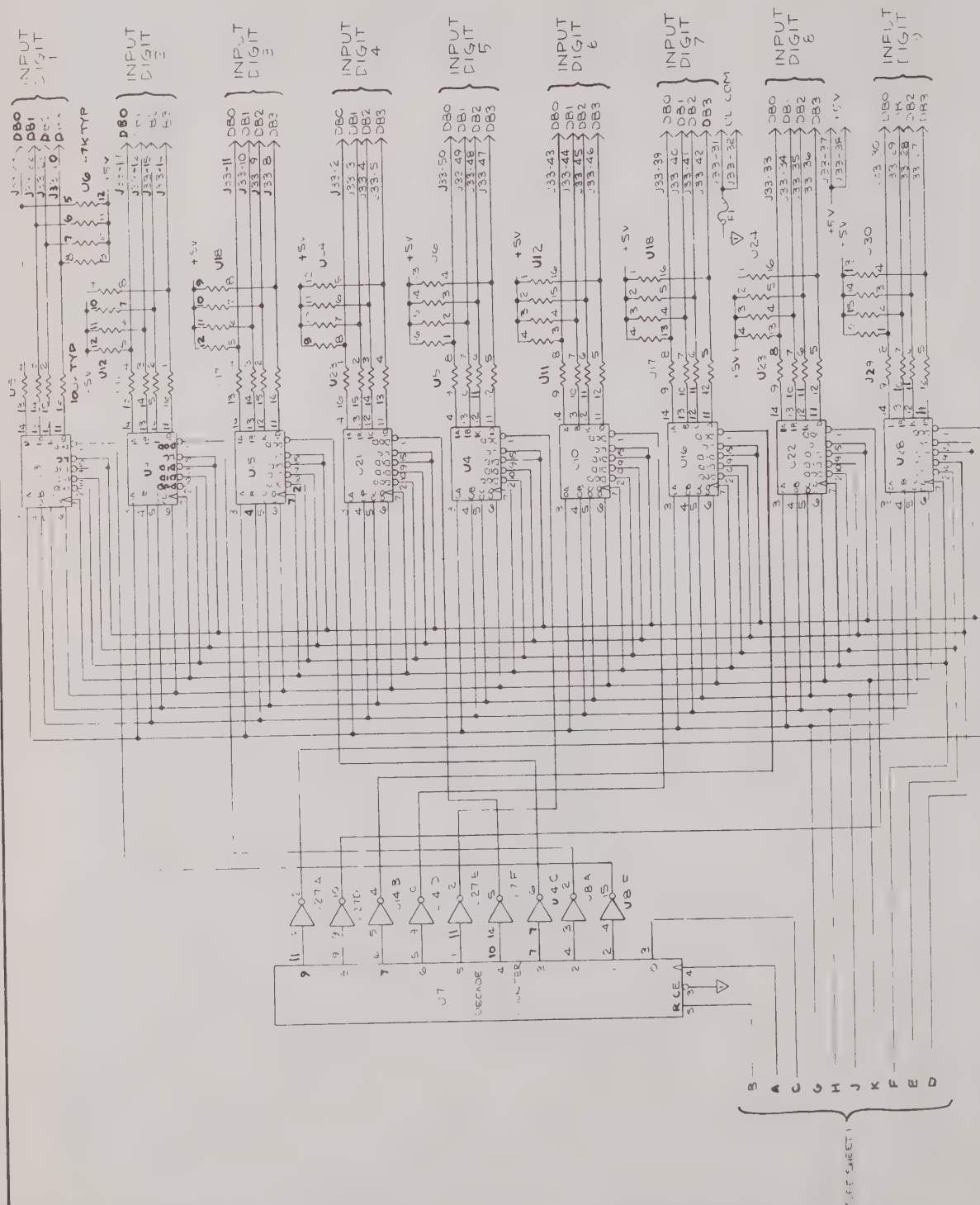


Figure 616-3. Digital Input PCB Assembly Option —16 (2200A-1017) (Sheet 3 of 3)

WIRE LIST	
FROM	TO CABLE/COLOR
PIB-1	CABLE 1 - GRY
↑ -2	↑ - GRN
-3	- RED
-4	- YEL
-5	- GRY/BLK
-6	- GRN/BRN
-7	- VIO
-8	- VIO/BLK
-9	- GRN/WHT
-10	- GRN/RED
-11	- YEL/WHT
↓ -12	↓ - GRN/BLK
-13	CABLE 1 - RED/GRY
-14	CABLE 2 - GRY
↑ -15	↑ - GRN
-16	- RED
-17	- YEL
-18	- GRY/BLK
-19	- GRN/BRN
-20	- VIO
-21	- VIO/BLK
-22	- GRN/WHT
-23	- GRN/RED
-24	- YEL/WHT
-25	- GRN/BLK
-26	- RED/GRY
-27	- RED/WHT
-28	- RED/GRN
-29	- VIO/WHT
-30	- GRY/WHT
-31	- VIO/RED
-32	- RED/BLK
-33	- YEL/GRY
-34	- GRY/RED
-35	- VIO/GRY
↓ -36	↓ - YEL/RED
-37	- GRY/GRN
-38	CABLE 2 - YEL/BLK
-39	CABLE 1 - RED/WHT
↑ -40	↑ - RED/GRN
-41	- VIO/WHT
-42	- GRY/WHT
-43	- VIO/RED
-44	- RED/BLK
-45	- YEL/GRY
-46	- GRY/RED
-47	- VIO/GRY
↓ -48	↓ - YEL/RED
↓ -49	↓ - GRY/GRN
PIB-50	CABLE 1 - YEL/BLK

GROUND LUG

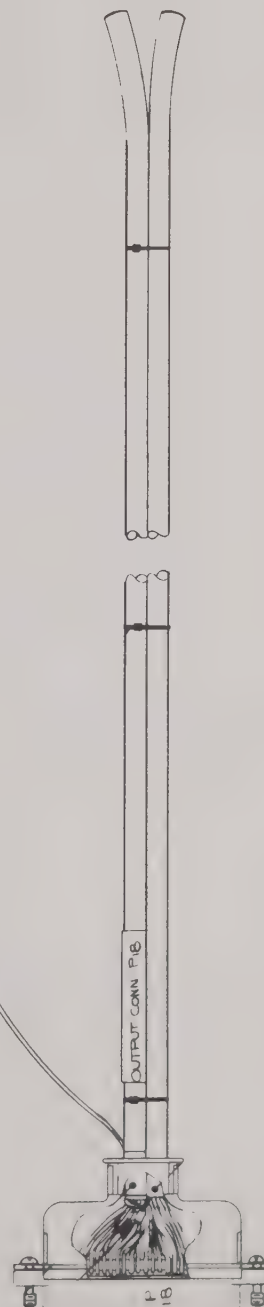


Figure 616-4. General Purpose Cable Assembly (2200A-4405)

Option —17 Remote Programming Interface

617-1. GENERAL

617-2. EIA Standard RS-232-C provides the electronics industry with the ground rules necessary for independent manufacturers to design and produce both data terminal and data communication equipment that conforms to a common interface requirement. As a result, a data communications system can be formed by connecting an RS-232-C data terminal (such as, the 2240B) to an RS-232-C data communication peripheral (such as, a TTY, MODEM, computer, etc.). This works fine on paper. However, in practice the user must be aware of the subtleties of serial binary data interchange to ensure that any two pieces of RS-232-C equipment will be compatible. For example, the two instruments must share at least one of the features from each of the following characteristics.

1. Timing Format - Synchronous or Asynchronous.
2. Transmission Mode - Simplex, half-duplex, or full duplex.
3. Baud Rate (bits per second) - 110, 150, 300, 600, 1200, 1800, 2400, 4800, 9600.
4. Bits per character - 5, 6, 7, 8.
5. Parity Bit - Odd, even, hi, low, not used.
6. Data Interface Levels - EIA or 20 mA current loop.

617-3. Timing formats conforming to both synchronous and asynchronous operation are shown in Figure 617-1. In asynchronous operation each character is

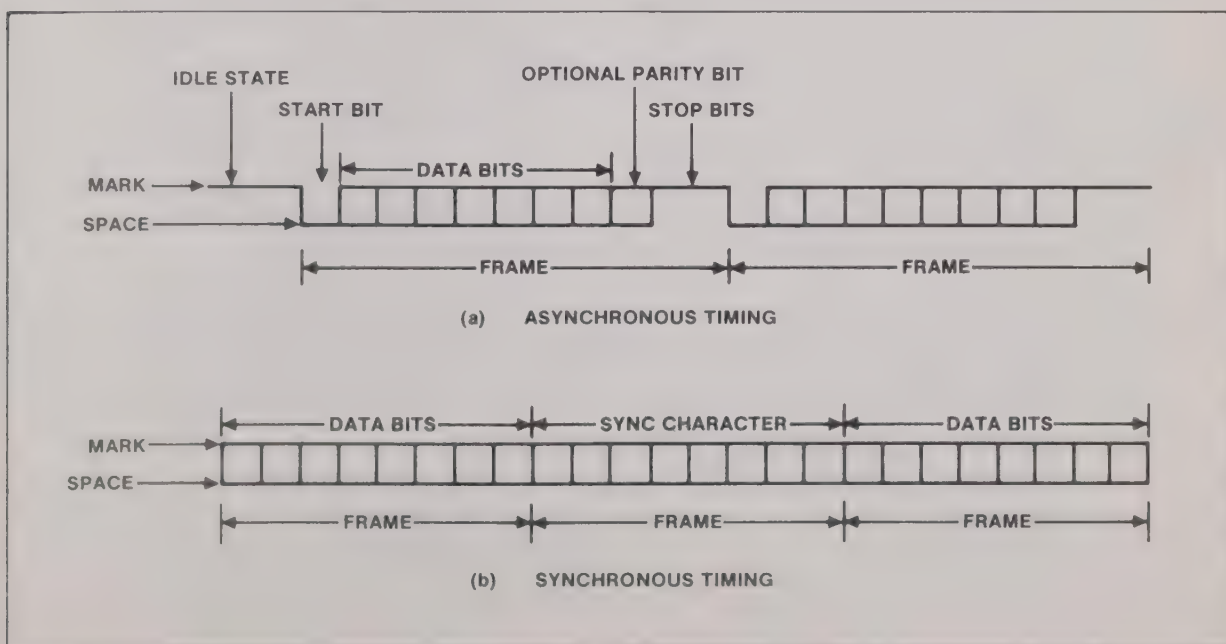


Figure 617-1. RS-232-C Timing Formats

bracketed by both start and stop bits. These bits separate the characters and synchronize both the transmission and receipt of data. When data is not being sent the data line is held high. In synchronous operation a sync character is sent prior to each data stream (a data stream usually consists of a block of characters). When the line is idle a fill or sync character is continuously transmitted.

617-4. Transmission mode is an overall system requirement. It defines the communication ability of both instruments in the system configuration. Simplex indicates data transmission in one direction only. Half-duplex permits two way communication, but not simultaneously. Simultaneous transmission of data in both directions defines the full duplex system. Obviously, an instrument capable of full-duplex operation can be down graded to simplex operation. However, the reverse is not possible without degrading the system capability.

617-5. Baud rate is usually selectable on the RS-232-C Interface. If it is not, the manufacturer usually offers a choice when the instrument is purchased.

617-6. Character format (bits per character and parity) is somewhat flexible between instruments. Investigate the requirement of both instruments before committing either to a system configuration.

617-7. Data interface levels can occur as either EIA voltage levels or as a 20 mA current loop. At times an interface offers both simultaneously. The 20 mA current loop is used almost exclusively for teletypewriter, or paper tape punch/reader interface. EIA voltage levels are: 1 or OFF=-15 to -3V dc, 0 or ON=+3 to +15V dc.

617-8. INTRODUCTION

617-9. The Remote Programming Option (-17) is designed to interface the Model 2240B Data Logger with an external, RS-232-C/20 mA current loop compatible data communication instrument, such as, a TTY, MODEM, computer, CRT, etc. It features asynchronous timing, full-duplex capability, selectable baud rate, choice of EIA or 20 mA current loop data levels, selectable parity for both transmit and receive, selectable character format (bits per character) and selectable output data format (lines per record, etc.). In addition, a unique address code can be assigned to the interface pcb. This code allows the interface to ignore all data not preceded by its assigned address character.

617-10. Option -17 is available in a variety of configurations as shown in Table 617-1. Order by model number and description. (Interface cable detail is given later under Operating Notes.)

617-11. SPECIFICATIONS

617-12. Specifications for the -17 Option are as follows:

Timing Format	... Anynchronous
Output Format	... Bit serial
Output Code	 Seven level ASCII
Data Buffer	 16 characters
Baud Rates	 110, 150, 300, 600, 1200, 1800, 2400, 4800, 9600
Operating Power	... Derived from data logger
Operating Temp	... 0 to 50°C

Table 617-1. Option -17 Configurations

MODEL NO.	DESCRIPTION
2240B-17A	Data Communication Interface Kit (PCB and Cable)
2240B-17B	Data Terminal Interface Kit (PCB and Cable)
2240B-17C	Current Loop (20 mA) Interface Kit (PCB and Cable)
2240B-17D	Hazeltine 1500 CRT Interface Kit (PCB, Cable, and CRT)
2240B-17E	Hazeltine 1500 CRT Terminal (115/230V ac, 60 Hz)
2240B-17F	Hazeltine 1500 CRT Terminal (220V ac, 50 Hz)
2240B-17G	Interface PCB (no cable)
2200A-7008	Interface Cable (-17A), Data Communications
2200A-7009	Interface Cable (-17B), Data Terminal
2200A-7010	Interface Cable (-17C), Current Loop (20 mA)
2200A-7011	Interface Cable (-17D), Hazeltine 1500 CRT

617-13. INSTALLATION

617-14. Interface PCB

617-15. The Remote Programming PCB Assembly can be installed in any one of the data logger I/O slots shown in Figure 617-2. use the following procedure to install the pcb:

WARNING

REMOVE LINE POWER AND ALL OTHER HIGH VOLTAGE INPUTS TO THE DATA LOGGER BEFORE STARTING THIS PROCEDURE.

- Set the data logger POWER switch to OFF.
- Remove the top cover from the data logger.
- Locate S3 on the pcb as shown in Figure 617-2. This switch is used to establish the format of transmitted data.
- With reference to Table 617-2 set 1 through 4 of S3 to establish the desired format.
- Locate S4 on the pcb as shown in Figure 617-2. This switch is used to establish the baud rate of both transmitted and received data.
- With reference to Table 617-3 set 1 through 4 of S4 to establish the desired baud rate.
- Locate S2 on the pcb as shown in Figure 617-2. S2 is used to assign a unique address code to the pcb. This code allows the pcb to ignore all command (data) strings that are not preceded by the code.
- With reference to Table 617-4 set 2 through 4 of S2 to assign the desired address character.
- Locate S1 on the pcb as shown in Figure 617-2.
- Refer to Table 617-5 and set 1 through 4 of S1 to define the interface and data characteristics of the pcb.
- Align the Remote Programming PCB in the selected I/O slot so that the female connector is toward the rear of the data logger, and the small board-edge connector is toward the bottom of the unit. Push the pcb straight down onto the mating connector.
- After the pcb is installed, install the top cover.

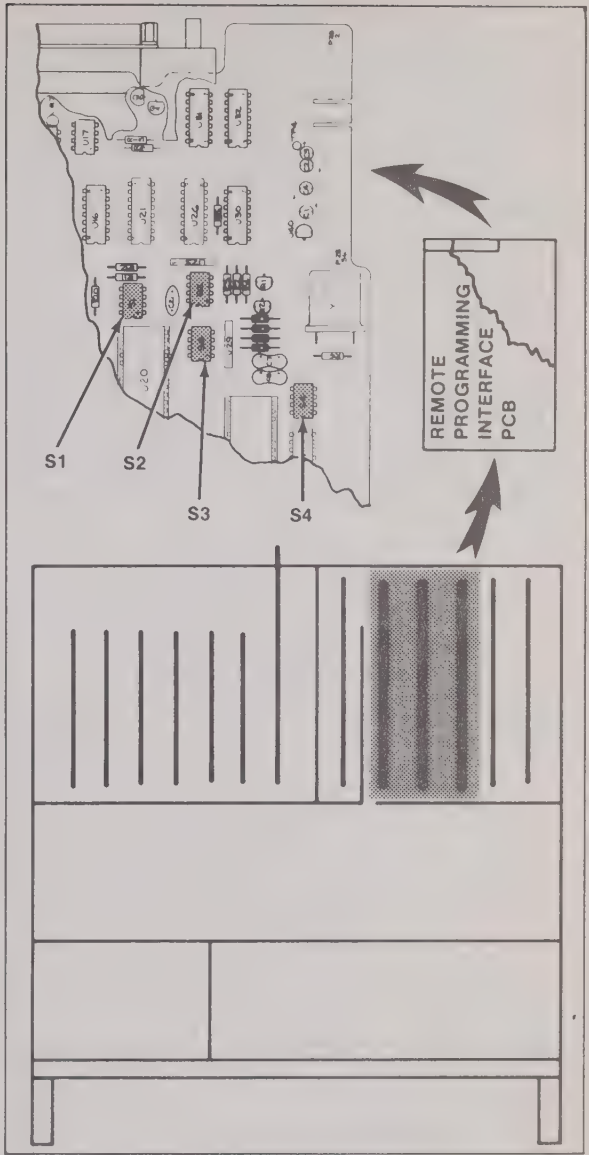


Figure 617-2. Remote Programming Interface PCB, Installation and Switch Locations

Table 617-2. S3 Switch Settings

S3 DEFINES THE FORMAT OF TRANSMITTED DATA CHARACTERS					
CHARACTER FORMAT			PARITY		
Bits Per Character	Position		Function	Position	
	3	2		1	4
5	On	On	Odd	On	On
6	On	Off	Even	Off	On
7	Off	On	None	X	Off
8	Off	Off	X — May be Off or On		

Table 617-3. S4 Switch Settings

S4 DEFINES THE BAUD RATE OF TRANSMITTED AND RECEIVED DATA				
BAUD RATE *	SWITCH POSITIONS			
	1	2	3	4
110	Off	Off	Off	Off
150	Off	Off	Off	On
300	Off	Off	On	Off
600	On	Off	Off	On
1200	Off	On	Off	Off
1800	Off	On	Off	On
2400	On	Off	Off	Off
4800	Off	On	On	Off
9600	Off	On	On	On

*One stop bit accompanies each character except at 110 baud where 2 stop bits are used.

Table 617-4. S2 Switch Settings

S2 DEFINES ADDRESS CODE ASSIGNED TO REMOTE PROGRAMMING PCB						
ADDRESS CHARACTER		POSITION				S2 CODE (HEX)
ASCII	Hex	4	3	2	1	
!	21	Off	Off	Off	See Note	0
"	22	On	Off	Off		1
#	23	Off	On	Off		2
\$	24	On	On	Off		3
%	25	Off	Off	On		4
&	26	On	Off	On		5
No Address	—	Off	On	On		6
Auto Answer	—	On	On	On		7

Note: S2 - P1, when set to ON, will cause a delay of ≈ 250 ms after each CR LF. When set to OFF no delay will occur.

Table 617-5. S1 Switch Settings

S1 DEFINES INTERFACE AND DATA CHARACTERISTICS		
POSITION	FUNCTION	SETTING
1	Controls echo of received characters to the peripheral.	On = Echo Off = No Echo
2	Selects number of analog readings per line (output data).	On = Four Off = One
3	Used in conjunction with U10 and U11 to alter the standard output format.	On = Special Off = Standard
4	Selects I/O data levels. 20mA Current Loop or EIA.	On = EIA Off = 20mA

617-16. Interface Cable

617-17. The peripheral is connected to the Remote Programming PCB by means of the interface cable. Connector P52 connects to the pcb, and P1 connects to the peripheral. Before actually installing the cable, refer to the interface information given later under Operating Notes and check to ensure that all required signal lines are present in the interface connection. If the 20 mA current loop interface is used, refer to operating notes for connection information.

617-18. OPERATING NOTES

617-19. The following paragraphs describe various conditions that should be considered before attempting to operate the Remote Programming Option.

617-20. Interface Cables

617-21. One-of-four, user specified, interface cables may be used with the Remote Programming Interface; i.e., -17A, -17B, -17C, or -17D. The 17A, 17B, and 17D cables are designed for use with an RS-232-C peripheral employing EIA data levels. The -17A cable has a male connector suitable for use with data communication equipment. The -17B cable has a female connector and is compatible with data terminal equipment. The -17D cable is compatible with the Hazeltine 1500 CRT Terminal. Signal and connection details are given in Table 617-6. Notice that all pins relating to the 20 mA current loop interface (*) are not connected (in cables 17A, 17B, and 17D). Equipment requiring a 20 mA current loop interface must therefore use the -17C cable. Connection details for this cable are given later in this section under Current Loop Interface.

617-22. Control Signals

617-23. All of the control signals specified in RS-232-C which have been implemented in the -17 Option are listed and described in the following paragraphs.

- DC - Data Terminal Ready - pin 20.
- CA - Request to Send - pin 4.
- CE - Ring Indicator - pin 22
- CF - Received Line Signal Detector - pin 8.
- CB - Clear to Send - pin 5.
- CC - Data Set Ready - pin 6.

617-24. Signals CF, CB, CC must be generated by the peripheral for all pcb address codes (S2) other than E. If address E is assigned to the pcb, the peripheral must also supply signal CE. If CA and CD or CE are not used, they should be left open. When CF, CB, and CC are not required they should be tied to an RS-232-C "ON" state (+3 to +15V dc with respect to signal common).

Table 617-6. Interface Cable Signals and Connections

Signal	REMOTE PROGRAMMING PCB		INTERFACE CABLE		
	J52	P52	P1	17A	17B, 17D
Protective Ground (Chassis)	1	1	→	1	1
Transmitted Data	2	2	→	2	3
Received Data	3	3	→	3	2
Request to Send	4	4	→	4	5
Clear to Send	5	5	→	5	4
Data Set Ready	6	6	→	6	20
Signal Ground	7	7	→	7	7
Received Line Signal Detector	8	8	→	8	20
Not Used	9	9	→	9	9
Not Used	10	10	→	10	10
I ₂ Current Source	11	11	•	11	11
-I _T Transmit (20mA)	12	12	•	12	12
+I _R Receive (20mA)	13	13	•	13	13
-I _R Receive (20mA)	14	14	•	14	14
Not Used	15	15	→	15	15
+I _T Transmit (20mA)	16	16	•	16	16
Not Used	17	17	→	17	17
-I Current Sink	18	18	•	18	18
-I Current Sink	19	19	•	19	19
Data Terminal Ready	20	20	→	20	6,8
Not Used	21	21	→	21	21
Ring Indicator	22	22	→	22	22
Not Used	23	23	→	23	23
Not Used	24	24	→	24	24
I ₁ Current Source	25	25	•	25	25

→ = Pins connected.

* = No connection between pins.

617-25. The automatic answer or switched service mode of operation is enabled when address code 7 is assigned to the Remote Programming PCB. In this mode the pcb polls Ring Indicator line (CE) for activity. When CE is turned on the pcb sets its Data Terminal Ready line (CD) to on. Then, after a 4 second delay it checks for both Data Set Ready (CC) and Received Line Signal Detector (CF) to be on, and CE to be off. When this condition is met, the pcb sets the Request to Send line (CA) to on and then checks the Clear to Send line (CB). if CB is on, a connection is made. Otherwise, no connection is made and the pcb sets CA and CD to off, and returns to polling the Ring Indicator (CE).

617-26. The dedicated line mode of operation is used for all address codes other than 7. In this mode the pcb sets the Data Terminal Ready line (CD) to the on state when power on occurs. It then polls for Data Set Ready (CC), and if on, sets the Request to Send line (CA) to on. In order, it then checks the Clear to Send (CB) and Received Line Signal Detector (CF). If both are on, then a data connection is made and the pcb is ready to receive data.

617-27. Current Loop Interface

617-28. The Remote Programming PCB is designed to transmit/receive data at either EIA voltage levels or 20 mA current loop levels. Switch S1, position 4 is used to select the desired data levels (see installation instructions). If the current loop levels are to be used, the -17C version of the interface cable must be employed. The -17 design is somewhat flexible in that it allows the current sources (transmit and receive) to be derived from either the Remote Programming PCB or the peripheral. Figure 617-3 illustrates the current loop I/O capabilities provided on the Remote Programming PCB. An example of current loop interface with a teletypewriter (Model ASR-33) is shown in Figure 617-4. When multiple data loggers are to be interfaced with a single peripheral, current loop connections similar to those shown in Figure 617-5 are recommended.

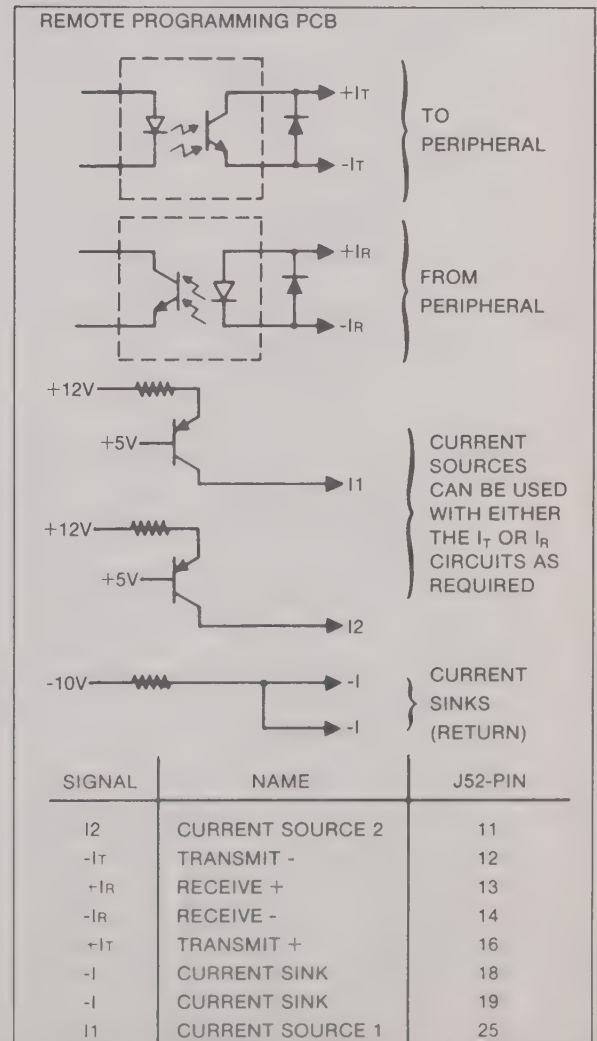


Figure 617-3. Current Loop Provisions on Remote Programming PCB

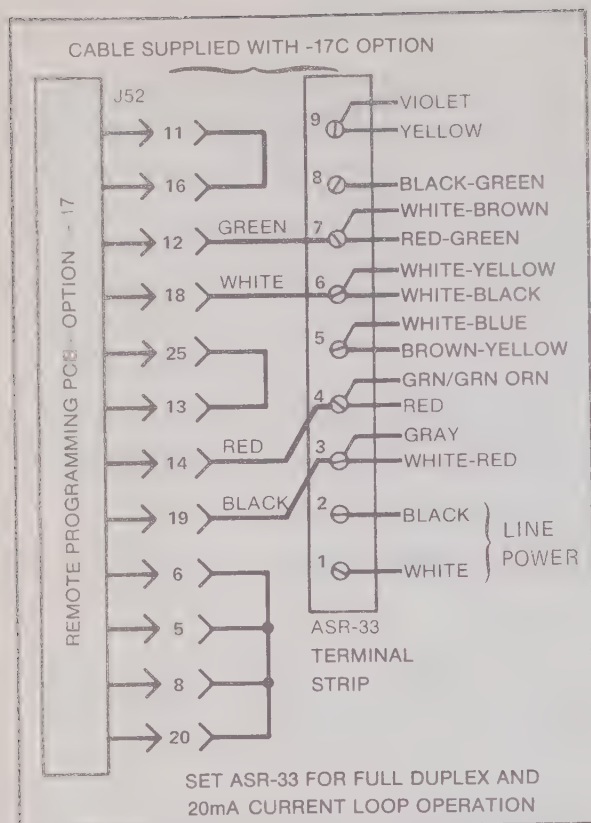


Figure 617-4. Connections Required for 20 mA Current Loop Interface with Model ASR-33 Teletypewriter

617-29. Programming Format

617-30. The Remote Programming PCB is capable of accepting a series or string of alpha-numeric characters and interpreting them as control/program data. These data (command) strings when properly formatted enable the remote peripheral to program the following data logger functions:

- Scan Control
- Output Control
- Time
- Scan Format
- Channel Programming
- Limits Programming

617-31. The format of the command string is shown in Figure 617-6. It consists of an address character, a command character, a numeric data field, and a carriage return terminator. The address character must correspond to that assigned (by #S2) to the interfaced Remote Programming PCB. An alphabetic command character follows to define the function to be programmed (scan control, output control, etc.). The commanded function is then programmed by a series of numeric characters. These characters represent a variable length numeric field and may contain a number of delimiters in the form of commas (,). After the numeric field is completed the command string is both terminated and executed by a carriage return (CR) character.

NOTE

A delimiter cannot be used for concatenation of command strings. Each string must be individually addressed and terminated.

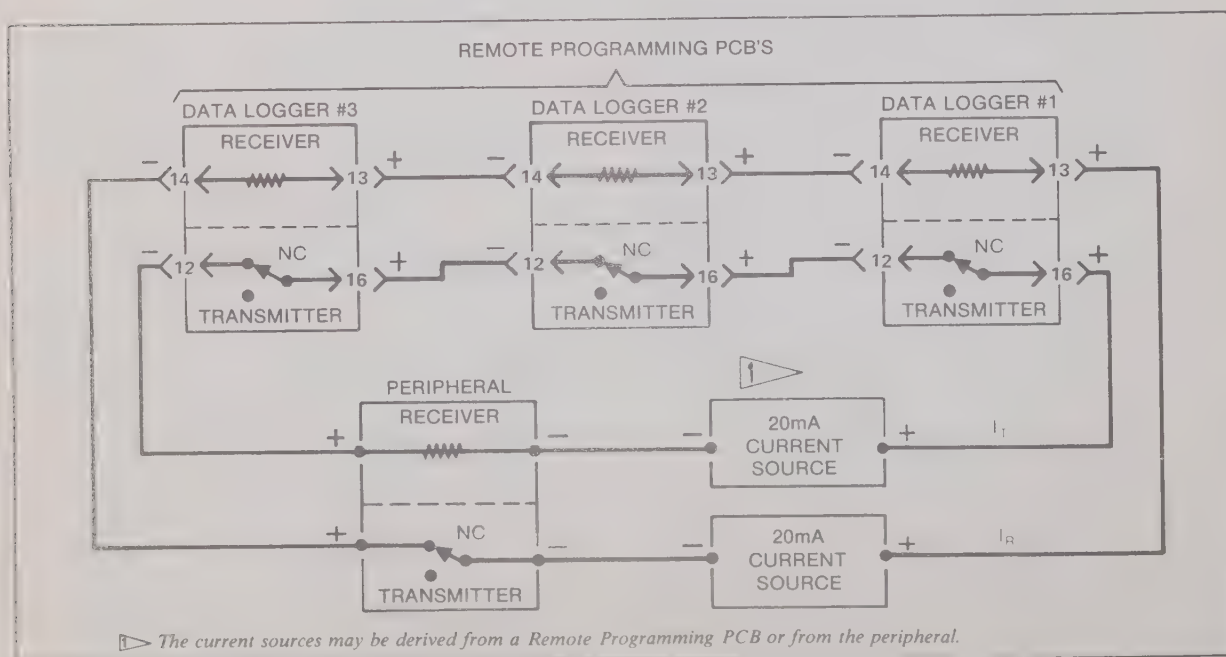


Figure 617-5. Current Loop Connections for Multiple Data Loggers

617-32. A complete list of command characters and their associated numeric fields are given in Table 617-7. Proper formatting of a typical programming sequence is shown in Table 617-8.

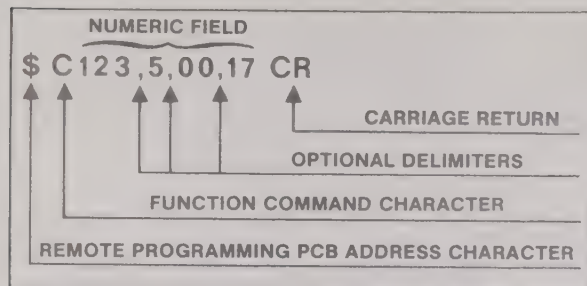


Figure 617-6. Command String Format Example

Table 617-8. Typical Programming Sequence

COMMAND STRING	COMMENTS
\$T123,23,50,31 CR	Time of Year
\$W4 CR	Output, All Data
\$F000 CR	First Channel = 0
\$L003 CR	Last Channel = 3
\$M001 CR	Monitor Channel = 1
\$C000,1,00,00 CR	Channel 0, 400 mV, Skip Limits
\$C001,6,01,16 CR	Channel 1, T1, Limits 1 & 16
\$C002,0,00,00 CR	Skip Channel 2
\$C003,4,33,16 CR	Channel 3, 4V, Limit 16
\$V01,3,2000 CR	Limit 1 = HI +2000
\$V16,1,1000 CR	Limit 16 = LO +1000
\$S1 CR	Continuous scan starts on CR.

Table 617-7. Definition of Command and Response Codes

COMMANDS*			COMMANDS*		
CODE	FORMAT	FUNCTION	CODE	FORMAT	FUNCTION
P	P	Outputs the program currently in memory	T	TWWW, XX, YY, ZZ	Sets Time of Year to WWW days, XX hrs., YY min., ZZ secs.
B	B	Automatic telephone transmission terminator	† C	Control C	Abort Command
A	A00	Sets Alarm Output/Resets all alarms	R	RWWW,X	Random Access any Channel
	ADD	Resets all Alarm Outputs (-23 Option)			Channel WWW (000-999) X = Range and Function Code same as Code C, does not program memory
		Sets specified Alarm DD = 01-30	X		Internal Printer Control
E		Enables local or remote control by -17 (must be enabled by switch internal to 2240B)		X0	No data printed
	EQ	Local Control		X1	Print alarm data
	E1	Remote Control		X2	Print interval data
		Scan Control, starts Data Logger		X3	Print alarm and interval data
	S0	Resets Data Logger Scan Control		X4	Print all data
	S1	Single Scan		X5	Print all data on alarm
	S2	Interval Scan		X6	Print all data and interval data
	S3	Monitor Scan		X7	Print all data on alarm and interval data
	S4	Continuous Scan	D		Response Control
W		Output Control (External Only)		D1	Deletes @ and all error responses
	W0	No data output		D2	Enables all responses including @
	W1	Alarm data only	F	FXXX	Sets First Channel to XXX (000-999)
	W2	Interval data only	L	LYYY	Sets Last Channel to YYY (000-999)
	W3	Alarm Data and Interval Data	M	MZZZ	Sets Monitor Channel to ZZZ (000-999)
	W4	All Data	H	HXXXXXX	Sets Fixed Data to XXXXXX (000000 999999)
	W5	All Data on Alarm		IXX, YY, ZZ	Sets the interval to XX hrs., YY min., ZZ secs.
	W6	All Data and Interval Data	* All commands must be entered in fixed field format, i.e., channel 23 → 023, Day 2 → 002.		
	W7	All Data on Alarm and Interval Data			
	VXX, Y, ZZZZ	Limits Value Sets Limit addressed by XX (01-30) to polarity and Sense Y, and Value ZZZZ. Y = 0 Low Y = 1+Low Y = 2 High Y = 3+High ZZZZ (0000 3999)	RESPONSES		
	CWWW,X,YY,ZZ	Channel Programs Channel Number WWW (000-999) to Range and Function X, with Limit A Address YY and Limit B Address ZZ X Range and Function 0 SKIP 1 40 mV 2 80 mV (calibration only) 3 400 mV 4 4V 5 40V 6 T1 7 T2 8 T3 9 T4 YY (01-15) Limit A ZZ (16-30) Limit B	CODE	DEFINITION	
			@<CR><LF>	Data Logger ready to accept next command	
			ERR01	Data Logger not in Remote	
			ERR02	Command string over 16 characters Command aborted with †C (control "C")	
			ERR03	Not a valid command	
			ERR04	Memory Error a) Individual programming Mode, Channel Number >255 b) Memory not available for channels above 127 c) Limits memory option not installed	
				A-D Function Error Random Access channel programming a) Function is not available b) Temperature option not installed Remote Command is not enabled	

617-33. Output Format

617-34. Output data from the interface pcb is recorded at the peripheral in the standard format shown in Table 617-9. A switch on the interface pcb (S1 position 2) allows selection (and printing) of either one or four measurement data readings per line.

617-35. Special formats are available on request (2240B-18, special output format option) and require the use of IC U10 with a custom program. The format variations are limited to those listed below. When ordering a special format, specify the variations using a form similar to that given in Figure 617-7.

- a. Data in any column can be deleted from any output field.
- b. Two characters can be substituted in the scan record; one at the beginning of the scan (prior to time of year), and one at the end of the last measurement data field (following LF).

- c. Character substitution is possible in some output fields. If an ASCII character is substituted for either the CR or LF, that character will appear in all output fields.
- d. The * in columns 12 and 13 of the measurement data field can only be substituted as a pair. The same is true of the space character in columns 14 and 15.
- e. The number of switch selectable measurement readings per line can be changed from one or four to one or n, where n is any integer from 1 through 16.
- f. When more than one analog measurement is recorded per line, they are separated by two spaces. Either one or both spaces may be deleted.

Table 617-9. Standard Output Format

DESCRIPTION	OUTPUT DATA *																	
Scan Start Character	<u>DC2</u>	<u>CR</u>	<u>LF</u>															
Time of Year	<u>Y</u>	<u>DC</u>	<u>DC</u>	<u>DC</u>	<u>:</u>	<u>H</u>	<u>H</u>	<u>:</u>	<u>M</u>	<u>M</u>	<u>:</u>	<u>S</u>	<u>S</u>	<u>CR</u>	<u>LF</u>			
Fixed Data	<u>X</u>	<u>FD</u>	<u>FD</u>	<u>FD</u>	<u>FD</u>	<u>FD</u>	<u>FD</u>	<u>CR</u>	<u>LF</u>									
Digital Input Data (Option-16)	<u>D</u>	<u>AC</u>	<u>AC</u>	<u>SP</u>	<u>DD</u>	<u>DD</u>	<u>DD</u>	<u>DD</u>	<u>DD</u>	<u>DD</u>	<u>DD</u>	<u>DD</u>	<u>DD</u>	<u>CR</u>	<u>FL</u>			
Measurement Data									SP	9	9	9	9	9	*	*	O	L
									SP	7	7	7	7	7	*	*	B	T
													SP	C	SP	SP		
													SP	F	SP	SP		
													M	V	SP	SP		
	<u>A</u>	<u>CH</u>	<u>CH</u>	<u>CH</u>	<u>SP</u>	<u>±</u>	<u>AD</u>	<u>AD</u>	<u>AD</u>	<u>.</u>	<u>AD</u>	<u>AD</u>	<u>SP</u>	<u>V</u>	<u>SP</u>	<u>SP</u>	<u>CR</u>	<u>LF</u>
Data Column I.D. (For Reference Purposes Only-Not Recorded)	<u>0</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>	<u>17</u>
End of Scan Character	<u>DC4</u>	<u>CR</u>	<u>LF</u>															

* **MNEMONICS:**

A = Measurement Data I.D.
AC = Address Code
AD = Analog Data
CH = Channel No.
CR = Carriage Return

D = Digital Input I.D.
DC = Day Code
DD = Digital Input Data
FD = Fixed Data
H = Hours
LF = Line Feed

M = Minutes
S = Seconds
SP = Space
X = Fixed Data I.D.
Y = Time of Year I.D.
* * OL = Overload

* * BT = Broken Thermocouple
_C _ = Degrees Celsius
_F _ = Degrees Fahrenheit
MV _ = Millivolts
_V _ = Volts

1. SUBSTITUTED OR DELETED CHARACTERS (Specify one ASCII character for each. If none is desired, so specify):

Scan Begin Character = _____, Scan End Character = _____

2. READINGS PER LINE (switch selectable)

1 or _____ (1 through 16)

3. DELETE THE FOLLOWING CHARACTER COLUMNS FROM THE DATA FIELDS SHOWN BELOW.

(Mark 'X' in columns to be deleted).

DATA FIELD	COLUMN																	
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
TIME OF YEAR																		
FIXED DATA																		
DIGITAL INPUT DATA																		
MEASUREMENT DATA							ANALOG DATA *											



4. USE SUBSTITUTE CHARACTERS IN THE OUTPUT DATA FIELDS SHOWN BELOW.

(List desired characters in the column provided). Substitution of CR or LF applies to all data fields.

DATA FIELD	COLUMN	STANDARD CHARACTER	SUBSTITUTE CHARACTER
TIME OF YEAR	4, 7 and 10	: (Colon)	
DIGITAL INPUT	3	SPACE	
MEASUREMENT DATA	4	>	
	4	<	
	4	SPACE	
	12	SPACE	
	12	m	
	12	SPACE	
	12	SPACE	
	12 and 13	*	
	13	V	
	13	V	
	13	F	
	13	C	
	14	O	
	14	B	
	15	L	
	15	T	
	14 and 15	SPACE	
ALL	—	CR	
	—	LF	

Figure 617-7. Special Format Instructions for 2240B—18 Option

617-36. OPERATION

617-37. Once installed, the Remote Programming Option requires no operator attention other than ensuring that normal turn-on procedures are observed for both the 2240B and its peripheral. Select the remote mode of operation either manually or remotely as required by the position of switch #1 on the 2240B's A3 Controller PCB (See Section 2, Figure 2-6 of the 2240B Instruction Manual). Follow the programming format given earlier to control the operation of the 2240B. Each of the remote programming functions correspond to the manual functions described in Section 2 of the 2240B Instruction Manual.

617-38. THEORY OF OPERATION

617-39. The Remote Programming PCB, as shown in Figure 617-8, is a microprocessor based subsystem which functions as an A3 Controller peripheral to provide the interface necessary to transfer 2240B program and output data to and from a remote, digital I/O, data terminal type device. Any one of several types of remote

data terminal instruments can be accommodated by the interface. Among these are: a 20 mA current loop teleprinter, paper tape reader/punch, or any RS-232-C compatible device capable of qualifying as a data terminal. Once the data terminal equipment is defined, the interface pcb is tailored to meet the interface requirements by setting a series of switches on the pcb. (See installation instructions for switch settings as they apply to this option.) These settings are read and stored by the MPU each time the data logger is turned on.

617-40. Operation of the Remote Programming PCB Assembly can be functionally divided into two sequences; transmit and receive. The transmit sequence involves the transfer of programming information from the data terminal to the A3 Controller in the 2240B. Conversely, the receive sequence involves the transfer of output data (scan and measurement data) from the data logger to the data terminal equipment. In both cases each I/O word (up to 16 characters) is temporarily stored on the interface pcb before being transferred to its final destination. This allows the interface pcb to synchronize its transfer operations with either the A3 Controller or the data terminal, as required.

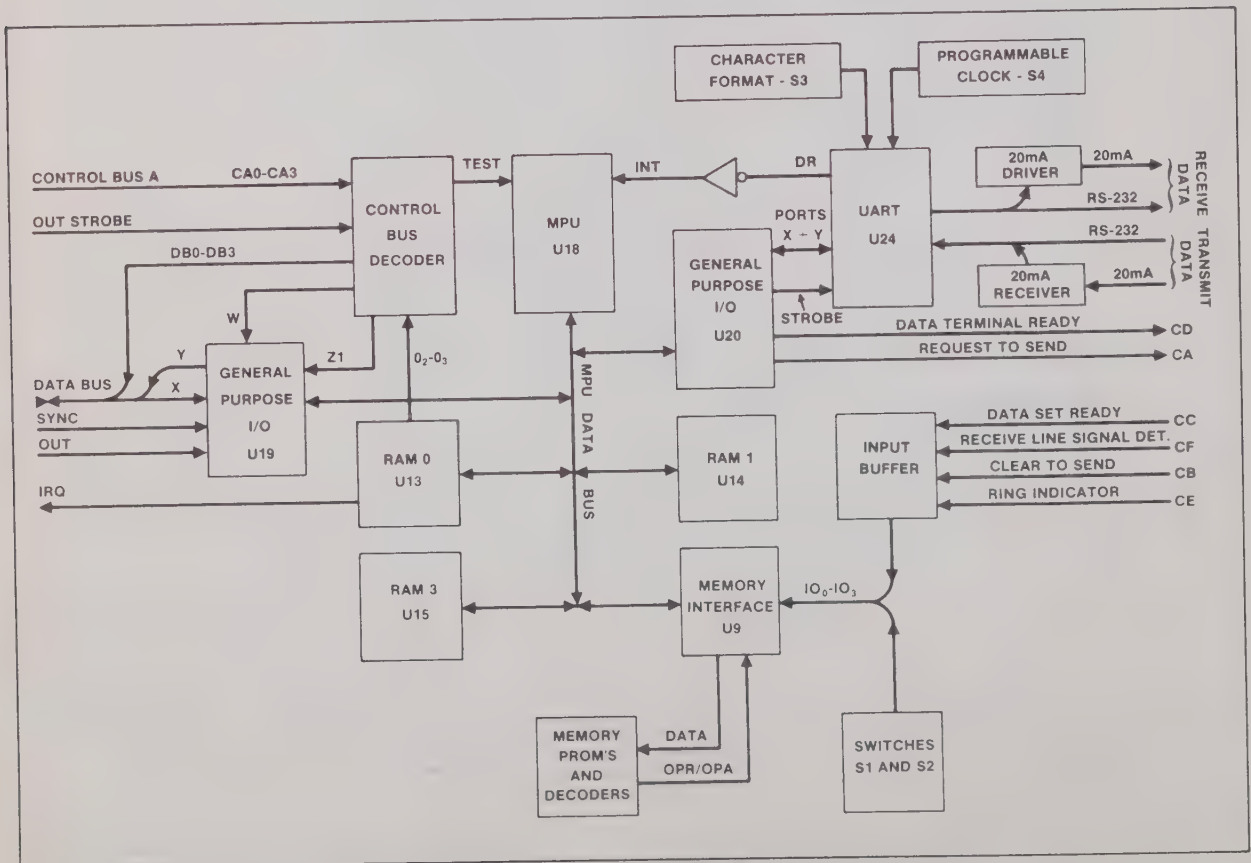


Figure 617-8. Remote Programming Option Simplified Block Diagram

617-41. Transmit Sequence

617-42. Character serial program data from the data terminal is received at the Remote Programming PCB as either 20 mA current levels or EIA (RS-232) voltage levels. The data is level shifted and/or buffered, and then used as the data input to a Universal Asynchronous Receiver Transmitter (UART). Data is received at the baud rate defined by switch S4, and in the format defined by switch S3. When a complete character is received, the UART generates a high (+5V dc) DR output. DR is inverted for use as the INT input to the MPU (microprocessor unit). In response to an INT input the MPU reads the parallel UART output character (I/O) via the General Purpose Input/Output (GP I/O) device U20 and the MPU Data Bus. The UART is prompted to output data by a strobe received from the GP I/O (U20). This strobe is initiated by the MPU via the Data Bus. After the character is read by the MPU, the strobe input resets the UART's DR output and, thus removes the INT input from the MPU.

617-43. Transmit data characters received by the MPU are transferred to and stored in RAM0. When a complete command (up to 16 characters) has been assembled, the MPU checks it for errors, and formats it for use by the data logger's A3 Controller. Then RAM0 initiates and IRQ (Interrupt Request) to notify the A3 Controller that the data is ready to be processed.

617-44. In response to the IRQ the A3 Controller begins to poll the various I/O pcb's to determine which pcb requested the interrupt and what service, if any, is required. To poll the Remote Programming PCB the A3 Controller places a binary coded 6 onto Control Bus A (CA0 - CA3). The pcb detects its code and responds with its current status via the Data Bus. The possible response codes and their meanings are shown in Table 617-10. When the Remote Programming PCB has initiated the interrupt request (IRQ), it confirms its action by placing a binary coded 7 on the Data Bus as a response code.

**Table 617-10. Remote Programming PCB
Response Codes**

BINARY CODED STATUS RESPONSE	DEFINITION
6	Interrupt Request and Busy
7	Interrupt Request (IRQ)
14	Busy
15	Not Busy, No Interrupt

617-45. When the A3 Controller is ready to receive data from the Remote Programming PCB, it places a binary coded 14 onto Control Bus A. The code is detected by the Control Bus Decoder which, in turn, enables data from port Y of the GP I/O (U19) to be placed onto the Data Bus. Concurrently, the MPU, on every Sync pulse, reads port W of the GP I/O (U19). When it detects a data request code (binary coded 14), it proceeds to transfer 16 characters to the A3 controller via port Y of the GP I/O (U19). At the end of the transfer, the Controller terminates the sequence by removing the binary coded 14 from the Control Bus.

617-46. Receive Sequence

617-47. When the A3 Controller is ready for the remote data terminal to receive data, it polls the status of the Remote Programming PCB by placing a binary coded 6 onto Control Bus A. If the pcb is not busy, it responds with a binary coded 15 via the Data Bus, and thereby prompts the Controller to initiate a Receive Sequence.

617-48. The Controller initiates a receive sequence by placing either a binary coded 4 or 11 onto Control Bus A. These codes are detected by the Control Bus Decoder on the Remote Programming PCB, and are used to indicate to the MPU (by driving its Test input high) that data is about to be received from the Controller. As subsequent data characters appear on the Data Bus, they are serially loaded into port X of the GP I/O (U19) by pulse Z1 (Z1 is derived from the Out strobe, and is enabled when binary codes 4 or 11 are on Control Bus A).

617-49. A total of 16 data characters are involved in each Receive Sequence. As they are transferred to the GP I/O (U19) they are also stored in RAM0 for further processing. When the transfer is completed the Controller removes the receive code (4 or 11) from Control Bus A to terminate the first phase of the Receive Sequence.

617-50. During the remainder of the Receive Sequence the MPU checks the content and format of the received data, and then, if all conditions at the data terminal are correct, formats the data for transfer to the data terminal. Before the transfer occurs the MPU polls the status of the UART and the data terminal input lines. If the UART is ready (TBRE output must be high), and the Received Line Signal Detector, the Clear to Send, and the Data Set Ready inputs are on, then data will be accepted by the UART. Each receive-data character is transformed into an ASCII seven-level character by the MPU before being presented to the UART via ports X and W of the GP I/O (U20). Strobe pulse Z0 is used to enter each serial character into the UART buffer. As each character is loaded, the correct parity (as determined by switch settings of S3) is assigned. Then the character is shifted

(serial-by-bit, LSB first) out of the UART as output or receive data. Data from the pcb is level-shifted and buffered to provide a choice of RS-232 voltage levels or 20 mA current levels as the data source to the data terminal.

617-51. MAINTENANCE

617-52. Access Information

617-53. Refer to the installation instructions given earlier in this subsection for Remote Programming PCB access information. Remove the rear panel output connector before attempting to remove the pcb from the data logger.

617-54. Performance Test

617-55. The Remote Programming PCB Assembly is most easily tested under normal operating conditions.

That is, installed in a functional data logger and interfaced with its normal peripheral. Output data can then be checked by comparing data recorded on the internal printer with hard copy data derived from the external recording device. Similarly, the effects of remote programming can be compared with manual programming to isolate malfunctions to the pcb level.

617-56. LIST OF REPLACEABLE PARTS

617-57. The lists of replaceable parts for the -17 Option are given in Tables 617-11 through 617-16. Refer to Section 5 of the data logger manual for ordering information.

CAUTION

 **Indicated devices are subject to damage by static discharge.**

Table 617-11. 2240B-17 Final Assembly

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	FINAL ASSEMBLY, 2240B-17 SERIES OPTIONS						
-17A	Data Communications Interface Kit 1, 2, 5 						
-17B	Data Terminal Interface Kit 1, 2, 6 						
-17C	Current Loop Interface Kit 1, 2, 7 						
17D	Hazeltine 1500 CRT Interface Kit 1, 2, 4, 8 						
17E	Hazeltine 1500 Terminal (115/230V ac, 60 Hz)						
17F	Hazeltine 1500 Terminal (220V ac, 50 Hz)						
-17G	Remote Programming PCB Kit 1, 2 						
	 Option components by item number. Description follows:						
1	Remote Programming PCB Assembly	2240A-4017T	89536	2240A-4017T	1		
2	IC, PROM set, remote programming control; U1, U2, U3, U6, U7, U8	457275	89536	457275	1		
4	Hazeltine 1500 Terminal (115/230V ac, 60 Hz)	413427	89536	413427	1		
5	Data Communications Interface Cable	2200A-7008	89536	2200A-7008	1		
6	Data Terminal Interface Cable	2200A-7009	89536	2200A-7009	1		
7	Current Loop Interface Cable	2200A-7010	89536	2200A-7010	1		
8	Hazeltine 1500 Interface Cable	2200A-7011	89536	2200A-7011	1		

Table 617-12. Remote Programming PCB Assembly

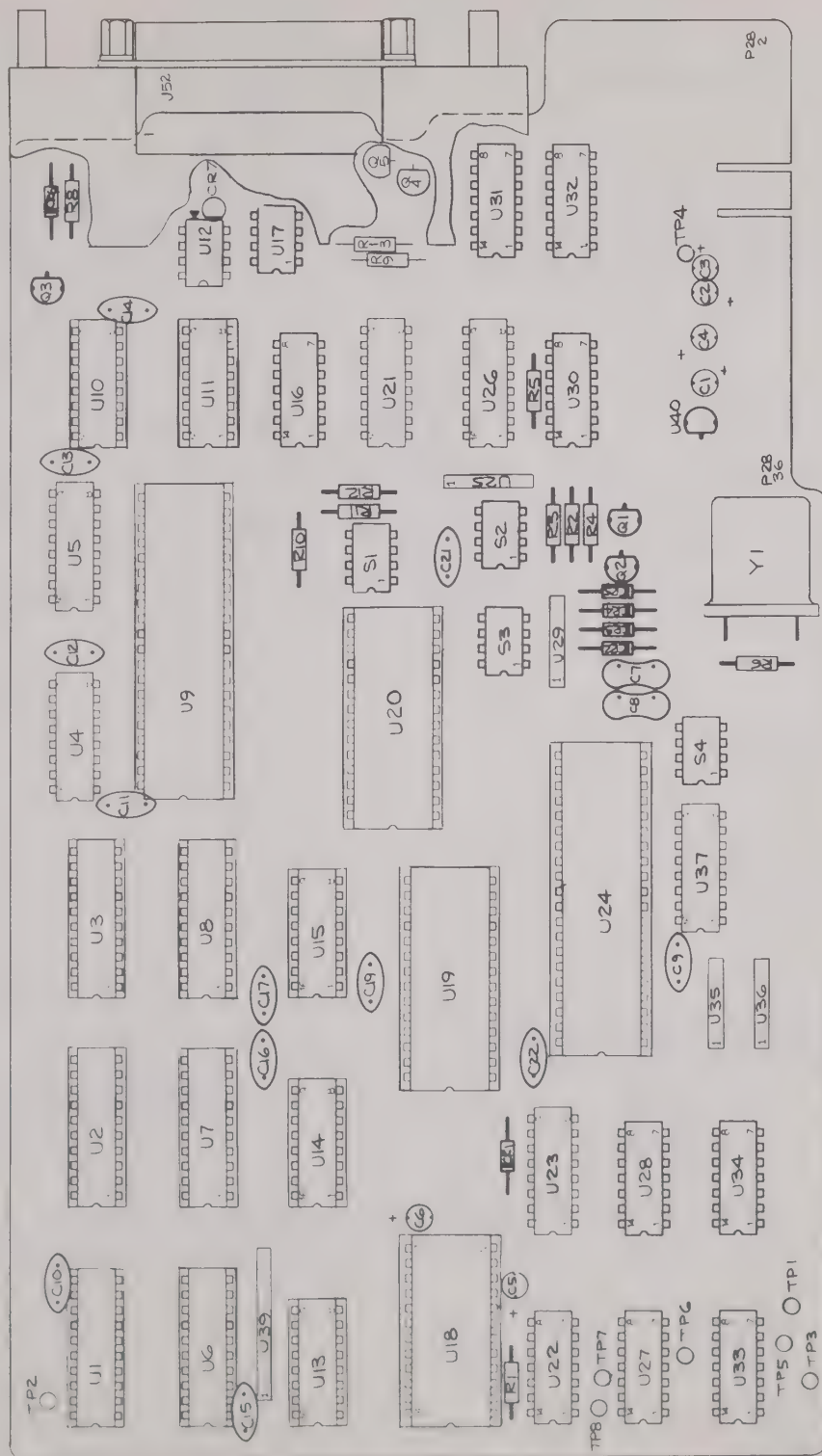
REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
1	REMOTE PROGRAMMING PCB ASSEMBLY (2240A–4017T) Figure 617-9				REF		
C1, C3	Tap, Ta, 0.33 μ F $\pm$ 20%, 35V	408690	56289	196D334 X0035HA1	2		
C2, C4	Cap, Ta, 10 μ F $\pm$ 20%, 20V	330662	56289	196D106 X0020KA1	2		
C5, C6	Cap, Ta, 1 μ F $\pm$ 20%, 35V	161919	56289	196D106 X0035JA1	2		
C7, C8	Cap, mica, 56 pF $\pm$ 5%, 500V	148528	72136	DM15560	2		
C9 thru C17, C19, C21, C22	Cap, cer, 0.05 μ F $-20/+80\%$, 25V	148924	72982	5855-Y50- 503Z	12		
CR1 thru CR6	Diode, Si, 150 mA, 75V	203323	09214	1N4448	6		
CR7	Diode, light emitting (LED) clear	385898	28480	5082-4487	1		
J52	Conn, female, 25-pin	413112	71785	DB25-SV	1		
Q1, Q4, Q5	Xstr, Si, PNP	195974	04713	2N3906	3		
Q2, Q3	Xstr, Si, NPN	218396	04713	2N3904	2		
R1, R2, R4, R5	Res, comp, 30k $\pm$ 5%, 1/4W	368753	01121	CB3035	4		
R3	Res, comp, 6.2k $\pm$ 5%, 1/4W	442368	01121	CB6625	1		
R6	Res, comp, 10M $\pm$ 5%, 1/4W	194944	01121	CB1065	1		
R7	Res, comp, 330k $\pm$ 5%, 1/4W	376640	01121	CB3045	1		
R8	Res, comp, 560 $\pm$ 5%, 1/4W	385948	01121	CB5615	1		
R9, R13	Res, comp, 270 $\pm$ 5%, 1/4W	348789	01121	CB2715	2		
R10	Res, comp, 24 $\pm$ 5%, 1/4W	442210	01121	CB2405	1		
R11, R12	Res, comp, 100k $\pm$ 5%, 1/4W	348920	01121	CB1045	2		
S1 thru S4	Switch Assembly, 4 spdt switches	408559	89536	408559	4		
U1, U2, U3, U6, U7, U8,	See Final Assembly (item 2)						

Table 617-12. Remote Programming PCB Assembly (cont)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U4, U5	IC, TTL, 4-to-10 line decoder	408716	01295	SN74LS42N	2		
U9	IC, MOS, standard memory interface (X)	404434	34649	P4289CA	1		
U13, U14	IC, MOS, RAM, 80 x 4, 4 output lines (X)	404442	34649	P4002-1	2		
U15	IC, MOS, RAM, 80 x 4, 4 output lines (X)	404467	34649	P4002-2	1		
U16, U31	IC, dgtl, quad line receiver	414045	12040	DS1489J	2		
U12, U17	IC, isolator, optically coupled	407742	28480	HP4351	2		
U18	IC, MOS, central processor unit (X)	404418	34649	4040	1		
U19, U20	IC, MOS, prog gen purpose (X)	453456	34649	P4265	2		
U21, U23, U26	IC, MOS, tri-state hex buffer (X)	407759	12040	MM80C97N	3		
U22	IC, MOS, quad 2-input NAND gate (X)	355198	02735	CD4011AE	1		
U24	IC, MOS, universal asynchronous receiver/ transmitter (X)	453464	32293	IM6402CPL	1		
U25, U29, U35, U36	Resistor Network, 100k $\pm$ 5%, 1/8W	412726	89536	412726	4		
U27, U33	IC, MOS, dual 4-input NAND gate (X)	355206	04713	MC14012CP	2		
U28, U34	IC, MOS, hex inverter	404681	02735	CD4069BE	2		
U30	IC, TTL, hex inverter	393058	01295	SN74LS04	1		
U32	IC, quad line driver	414052	12040	LM1488N	1		
U37	IC, MOS, programmable bit rate generator (X)	418731	07236	F40702/ 34702	1		
U39	Resistor Network, 10k $\pm$ 5%, 1/8W	414003	89536	414003	1		
U40	IC, Lin, pos voltage regulator	408138	04713	78L12WC	1		

Table 617-12. Remote Programming PCB Assembly (cont)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Y1	Crystal, 2.4576 MHz	435370	89536	435370	1		
	Bracket, connector	456566	89536	456566	1		
	Hardware Kit	448092	89536	448092	1		
	Socket, IC DIP, 20-pin	454421	01295	C932002	6		
	Socket, IC, DIP, 24-pin	418970	91506	324-AG39D	1		
	Socket, IC, DIP, 28-pin	448217	91506	328-AG39D	2		
	Socket, IC, DIP, 40-pin	418988	91506	340-AG39D	2		
	Socket, IC, DIP, 16-pin	276535	91506	316-AG39D	5		



(2240A-1617)

Figure 617-9. Remote Programming PCB Assembly

Table 617-13. Data Communications Interface Cable Assembly

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
5	DATA COMMUNICATIONS INTER- FACE CABLE ASSEMBLY, RS-232-C Figure 617-10	2200A-7008			REF		
P1, P52	Connector, 25-pin, male	312587	71785	DB-25P	2		
	ID, cable, P1	453753	89536	453753	1		
	ID, cable, P52	453936	89536	453936	1		
	Grommet, rubber	100065	83330	2174	2		
	Strain relief	436642	71785	DB51226-1	2		

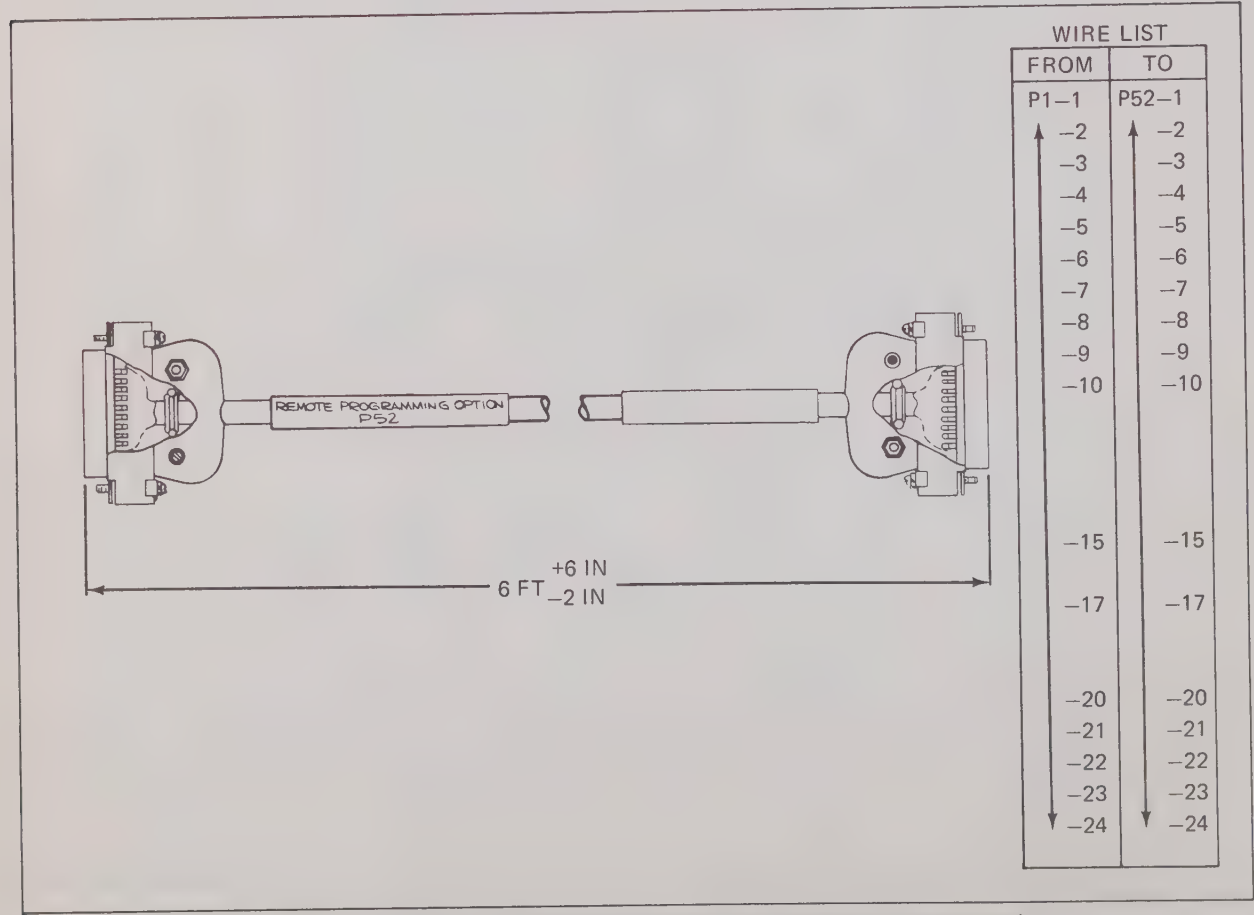


Figure 617-10. Data Communications Interface Cable Assembly (2200A-7008)

Table 617-14. Data Terminal Interface Cable Assembly

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
6	DATA TERMINAL INTERFACE CABLE ASSEMBLY, RS-232-C Figure 617-11	2200A-7009			REF		
P1	Connector, 25-pin, female	312579	71785	DB-25S	1		
P52	Connector, 25-pin, male	312587	71785	DB-25F	1		
	ID, cable, P1	472837	89536	472837	1		
	ID, cable, P52	453936	89536	453936	1		
	Grommet, rubber	100065	83330	2174	2		
	Strain relief	436642	71785	DB51226-1	2		

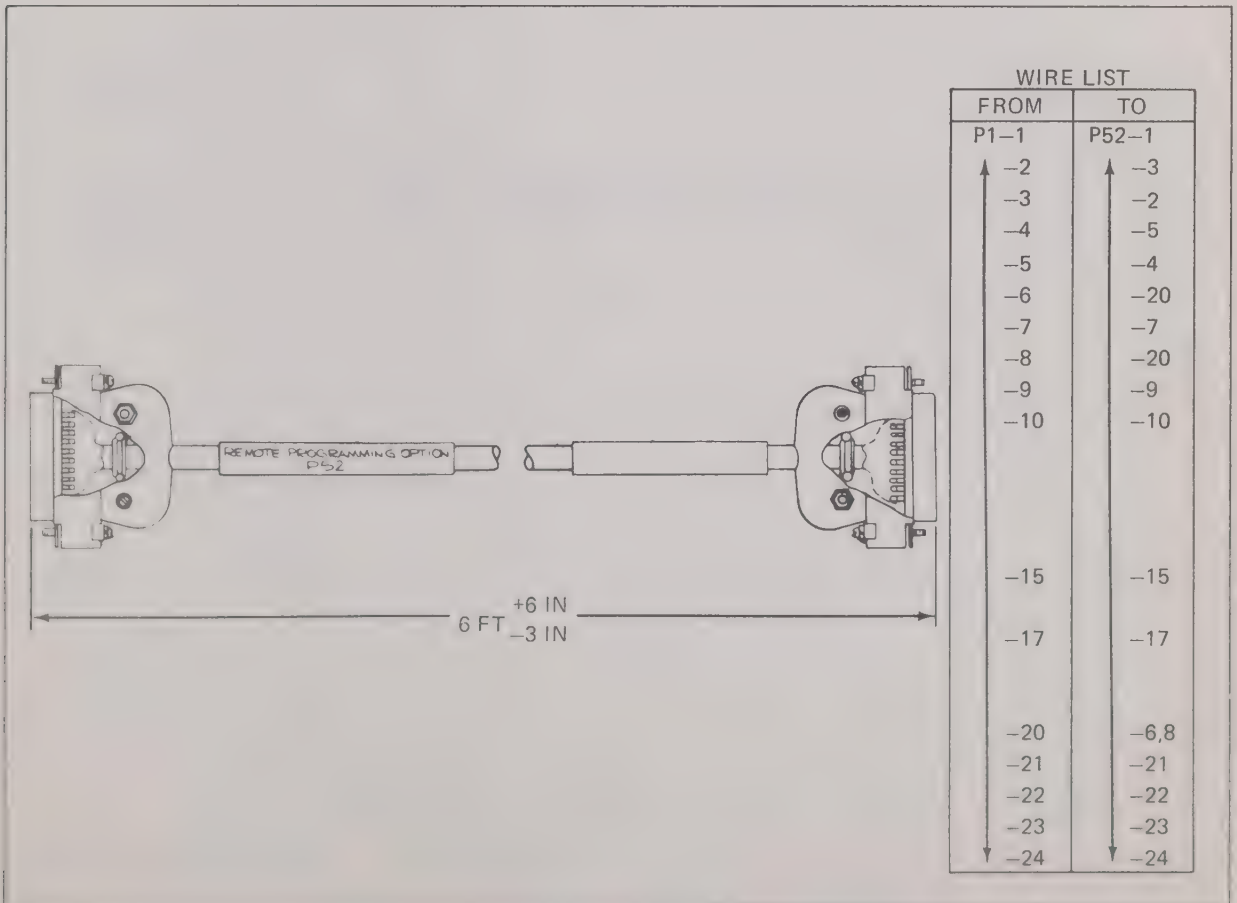


Figure 617-11. Data Terminal Interface Cable Assembly (2200A-7009)

Table 617-15. Current Loop Interface Cable Assembly

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
7	CURRENT LOOP INTERFACE CABLE ASSEMBLY, 20 mA Figure 617-12	2200A-7010			REF		
P52	Connector, 25-pin, male	312587	71785	DB-25P	1		
	Terminal, spade-lug	435552	89536	435552	4		
	ID, cable, P52	453936	89536	453936	1		
	Grommet, rubber	100065	83330	2174	1		
	Strain relief	436642	71785	DB51226-1	1		

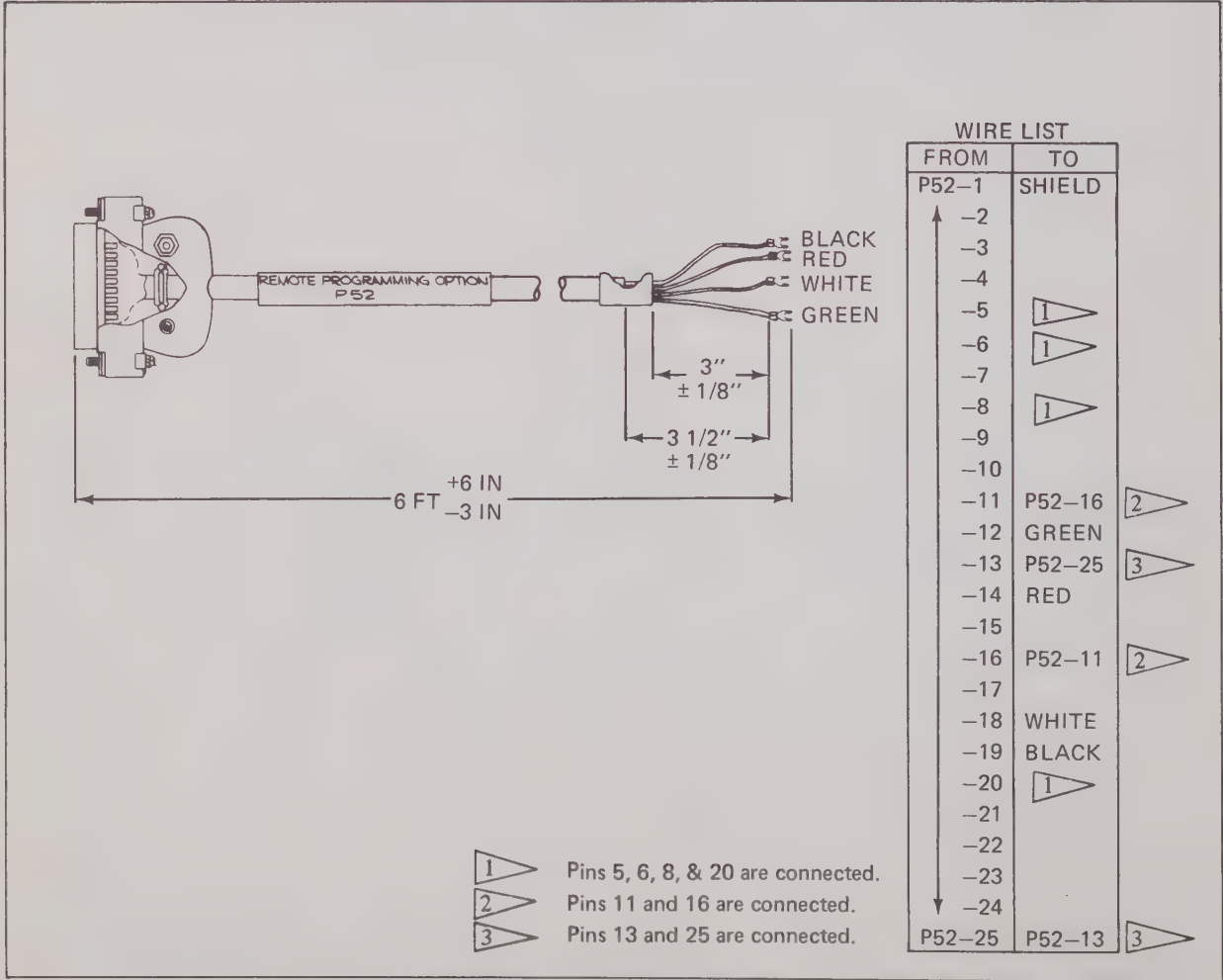


Figure 617-12. Current Loop Interface Cable Assembly (2200A-7010)

Table 617-16. Hazeltine 1500 Interface Cable Assembly

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
8	HAZELTINE 1500 INTERFACE CABLE ASSEMBLY Figure 617-13	2200A-7011			REF		
P1, P52	Connector, 25-pin, male	312587	71785	DB25P	2		
	Grommet, rubber	100065	83330	2174	2		
	ID, cable, P52	453936	89536	453936	1		
	Strain relief	436642	71785	DB51226-1	1		

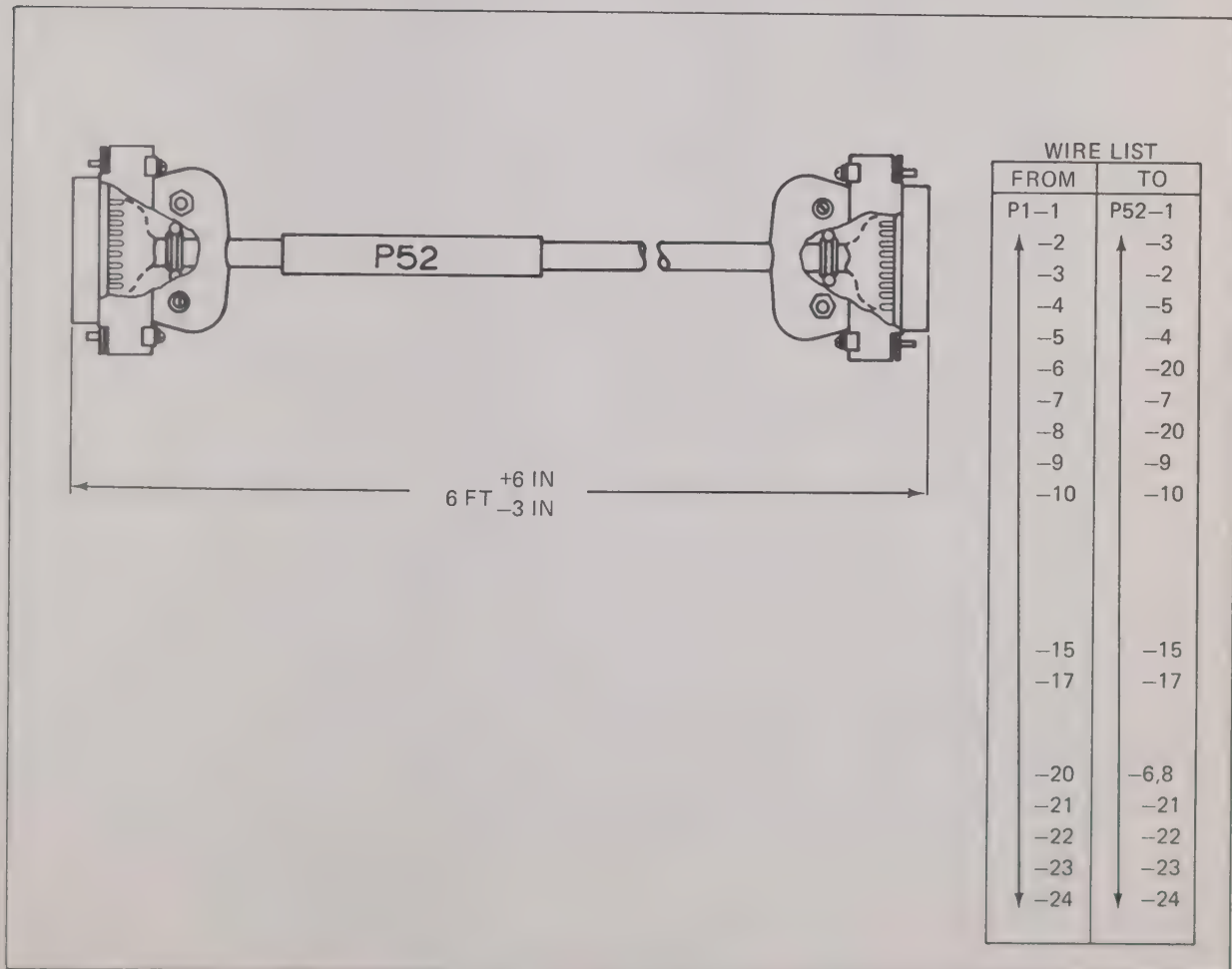


Figure 617-13. Hazeltine 1500 Interface Cable Assembly (2200A-7011)

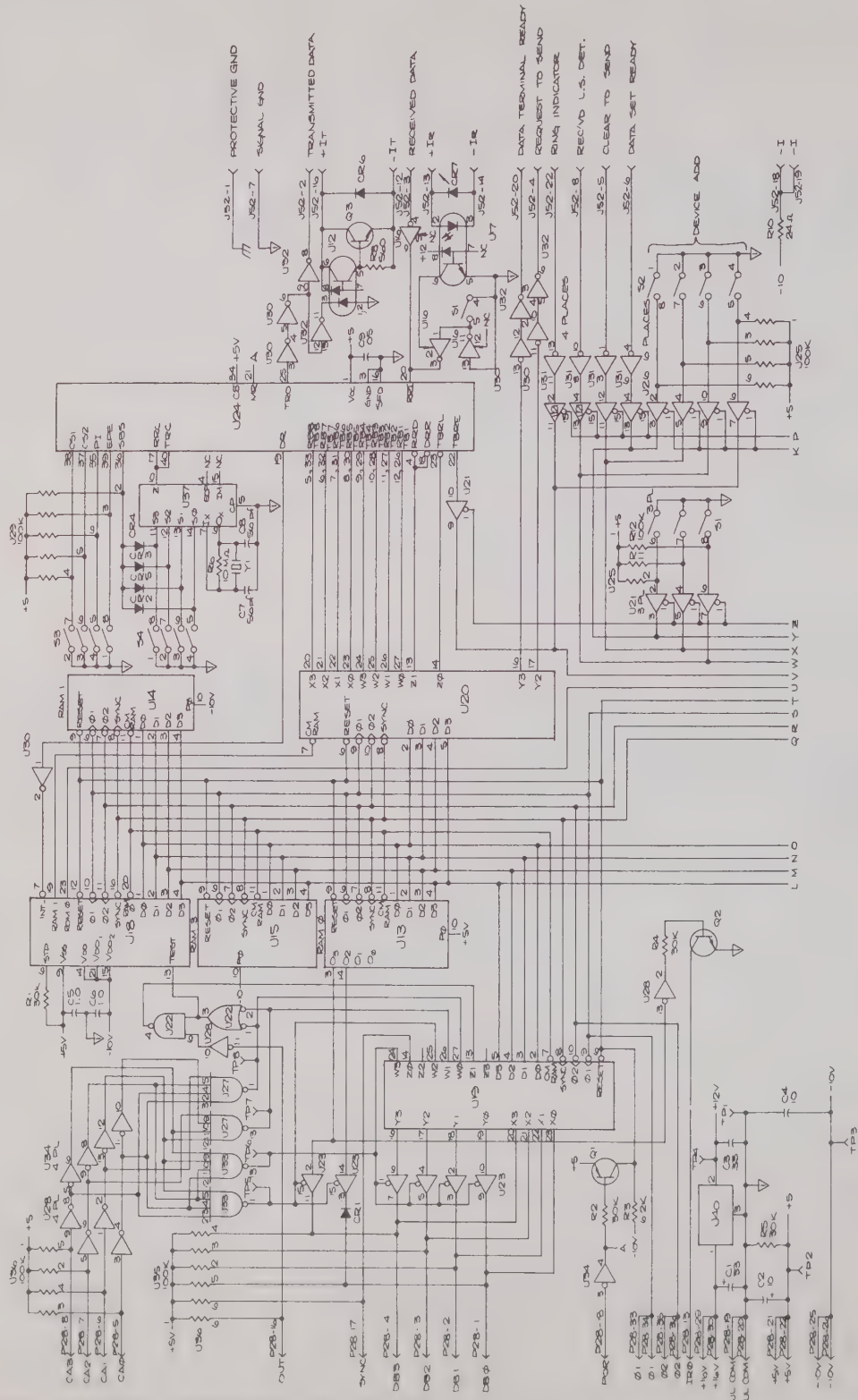


Figure 617-14. Remote Programming PCB Assembly

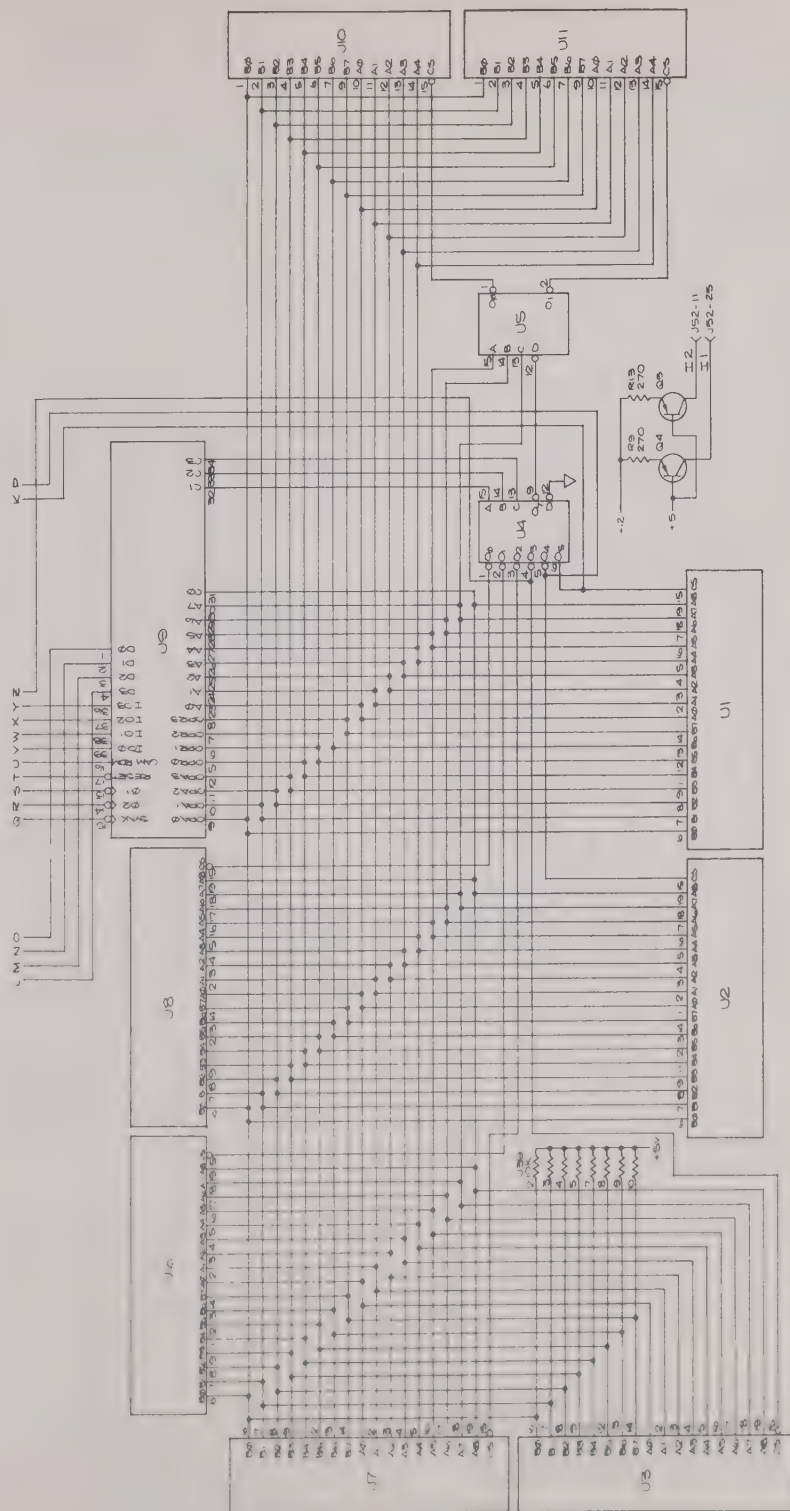


Figure 617-14. Remote Programming PCB Assembly (cont)

Option —20 Program Memory Expansion

620-1. INTRODUCTION

620-2. Program Memory Expansion is a factory installed option (—20) that increases the 2240A's program function memory from 128 individual channels to either 256 individual channels or 170 individual channels plus 83 blocks of 10 channels each. Selection of either mode is accomplished by setting a switch on the interior of the 2240A. If the block mode is selected, a total of 1000 channels can be programmed; i.e., 170 individual channels plus 83 blocks of 10 channels ($170 + [83 \times 10] = 1000$).

620-3. SPECIFICATIONS

620-4. Specifications for the Program Memory Expansion Option (—20) are given in Table 620-1.

620-5. OPERATION

620-6. Front panel operation of the Program Memory Expansion Option is covered in Section 2 of the 2240A Instruction Manual. Instructions for selecting the operating mode (Block/Individual) are given in Figure 620-1.

WARNING

REMOVE LINE POWER AND ALL OTHER HIGH VOLTAGE INPUTS TO THE DATA LOGGER BEFORE ATTEMPTING TO SET THE MODE SWITCH.

Table 620-1. Program Memory Expansion Specifications

Channel Capacity	Expands basic unit capacity from 128 to 256 channels.
Memory Configuration	256 individual channels or 170 individual channels plus 83 blocks of 10 channels for a total of 1000 channels. Desired configuration is manually selected by internal switch.

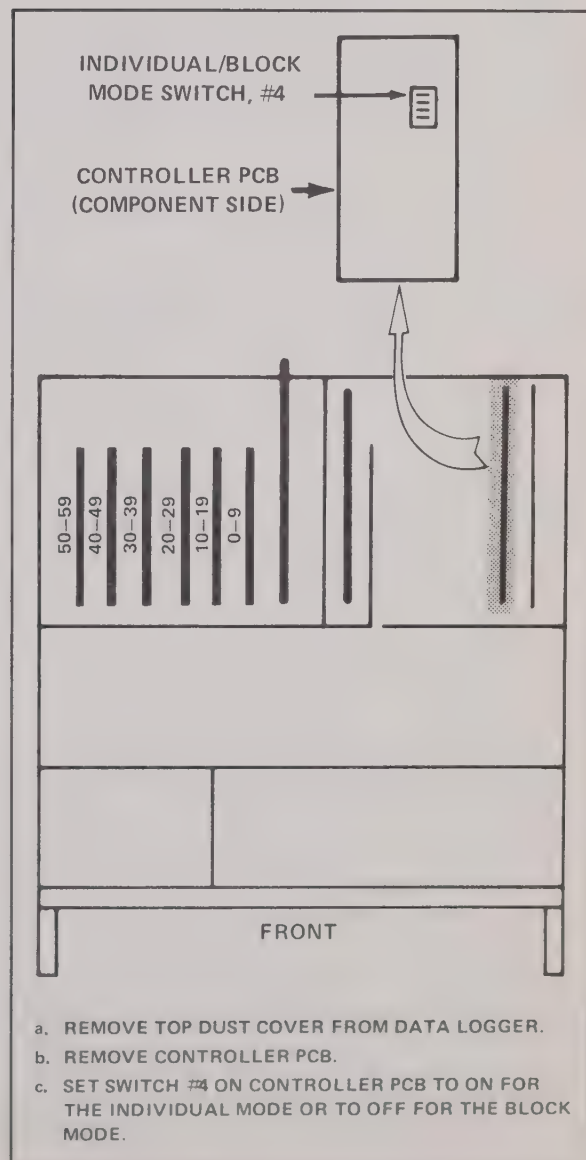


Figure 620-1. Switch Selection of Individual or Block Mode

Option —21

Alarm Set Points — Seven Single Limits

621-1. INTRODUCTION

621-2. The Seven Single Limits Alarm Set-Point Option (—21) is a factory installed set of IC's that provide memory for seven single limit values and 128 alarm limit address (one address for each channel). Limit values and channel assignments are entered via the 2240A's DATA ENTRY keyboard. Dual limit capability (high and low per channel) and/or extended single limit capability (15 single limit values) is achieved when two of the seven single-limit options are installed.

621-3. The seven limit values provided by the Alarm Set Option are individually addressable using a two-digit limit address code. LIMIT A address codes (01 through 07) are assigned to the first set of seven limits, and LIMIT B address codes (16 through 22) are assigned to the second set of seven limits. During a

channel programming sequence, the operator is able to address, and thereby assign any one limit value from each group to the addressed channel. The actual limit value assigned to a given limit address is determined by the operator during a limits programming sequence.

621-4. SPECIFICATIONS

621-5. Specifications for the Seven Single Limits Alarm Set Point Option are given in Table 621-1.

621-6. OPERATION

621-7. Once installed, the alarm set point option(s) require no operator attention. Instructions for programming the limits from the 2240A front panel are given in Section 2 of the main manual.

Table 621-1. Alarm Set-Points Specifications (Seven Single Limits)

Alarm Limit Values	Memory is provided for assigning 7 single-limit values (polarity, four-digits and HI/LO sense) to ADDRESS LIMIT A (address codes 1 through 7). If two —21 options are installed, memory is provided for seven additional limit values. The second seven limit values are assigned to LIMIT ADDRESS B (address codes 16 through 30).
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Alarm Limit Addresses	Memory is provided to allow any one-of-seven limit values to be assigned to each of the first 128 channels using ADDRESS LIMIT A (address codes 1 through 7). If two options are installed, any one-of-seven limit values from either or both ADDRESS LIMIT A and B can be assigned to each of the first 128 channels (address 1 through 7 and 16 through 22).
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Option —22 Fifteen Single Limit Alarm Set Points

622-1. INTRODUCTION

622-2. The Fifteen Single Limits Alarm Set Point Option (—22) is a factory installed set of IC's that provides memory for 15 single limit values and 256 alarm limit addresses (Option —20 must be installed for the 256 channel capability). Limit values and channel assignments are entered via the 2240A's DATA ENTRY keyboard. Dual limit capability (high and low per channel) and/or extended single limit capability (30 single limit values) is achieved when two of the Fifteen Single Limit Set Point Options are installed.

622-3. The 15 limit values provided by the Alarm Set Point Option are individually addressable using a two-digit limit address code. LIMIT A address codes (01 through 15) are assigned to the first set of 15 limits, and LIMIT B address codes (16 through 30) are assigned to the second set of limits. During a channel programming

sequence, the operator is able to address, and thereby assign any one limit value from each group to the addressed channel/block. The actual limit value assigned to a given address is determined by the operator during a limits programming sequence.

622-4. SPECIFICATIONS

622-5. Specifications for the Fifteen Single Limits Alarm Set Point Option are given in Table 622-1.

622-6. OPERATION

622-7. Once installed, the alarm set point option(s) require no operator attention. Instructions for programming the limits from the 2240A front panel are given in Section 2 of the main manual.

Table 622-1. Alarm Set Point Specifications (Fifteen Single Limits)

Alarm Limit Values	Memory is provided for assigning 15 single-limit values (polarity, four digits and HI/LO sense) to ADDRESS LIMIT A (address codes 1 through 15). If two —22 options are installed, memory is provided for 15 additional limit values. The second 15 limits values are assigned to LIMIT ADDRESS B (address codes 16 through 30).
Alarm Limit Addresses	Memory is provided to allow any 1-of-15 limit values to be assigned to each of the first 256 channels (or 170 channels and 83 blocks) using ADDRESS LIMIT A (address codes 1 through 15). If two options are installed, any 1-of-15 limit values from either or both ADDRESS LIMIT A and B (address codes 1 through 30) can be assigned to each of the first 256 channels (or 170 channels and 83 blocks).

Option -23 Alarm Set Point Output

623-1. INTRODUCTION

623-2. The Alarm Set Point Output (Option -23) is a plug-in pcb assembly designed to operate in any one of the data logger's I/O slots. Its function is to provide an external output when a measurement at any channel exceeds an assigned limit value. The output is in the form of 30 separate open-collector transistors. Each output is identified by number (1 through 30) on the pcb.

623-3. When Option -23 is used in the 2240B each of the 30 outputs correspond to 1-of-30 possible limit addresses. An active (turned-on) output transistor indicates that the limit value of the corresponding limit address is assigned to the previously measured channel, and that the measurement exceeded the limit value. Memory included on the pcb maintains all limit-exceeded indications until a reset, either manual or remote, is received. The manual reset is located on the 2240B front panel, above the power switch. A front panel LIMIT EXCEEDED lamp, located next to the RESET switch, flashes when one or more limit values have been exceeded.

623-4. When Option -23 is used in a 2200B only 14 of the 30 outputs are used. Ten are used to denote a limit exceeded condition on individual channels or on blocks of 10 channels depending upon the selected programming mode, individual or block. The remaining four outputs identify which of the four limits (assigned to that channel or block) has been exceeded. Thus, the 14 outputs are capable of identifying a total of 40 unique limits. Memory on the pcb maintains all limit-exceeded indications until a reset, either manual or remote, is received. The manual ALARM RESET switch is located on the 2200B front panel in the SCAN CONTROL switch group.

623-5. SPECIFICATIONS

623-6. Specifications for the Alarm Set Point Output (Option -23) are given in Table 623-1.

623-7. INSTALLATION

623-8. The Alarm Set Point Output PCB can be mounted in any one of the data logger's I/O slots, as shown in Figure 623-1. Install the pcb as follows:

WARNING

REMOVE LINE POWER AND ALL OTHER HIGH VOLTAGE INPUTS TO THE DATA LOGGER BEFORE STARTING THIS PROCEDURE.

1. Set the data logger's POWER switch to OFF.
2. Remove the top cover from the data logger.
3. Refer to the Alarm Relays in paragraph 623-19 and ensure that the proper jumpers are installed.
4. Align the Alarm Set Point Output PCB in the selected I/O slot so that the large female connector is toward the rear of the data logger, small board-edge connector is toward the bottom of the unit. Push the pcb straight down onto the mating connector.
5. After the pcb is installed, install the top cover.

Table 623-1. Alarm Set Point Output Specifications

Compatibility	
2240B	Used in conjunction with Option -22
2200B	Used in conjunction with Option -34 (2200B-34)
Number of Outputs	30 open-collector outputs (one output for each limit value)
Uncommitted Relays	2 (These relays can be hard wired to any or all of the 30 set point outputs)
Open Collector Output Current	30 mA maximum
Relay Contact Rating	50V/1A (15 watts maximum)

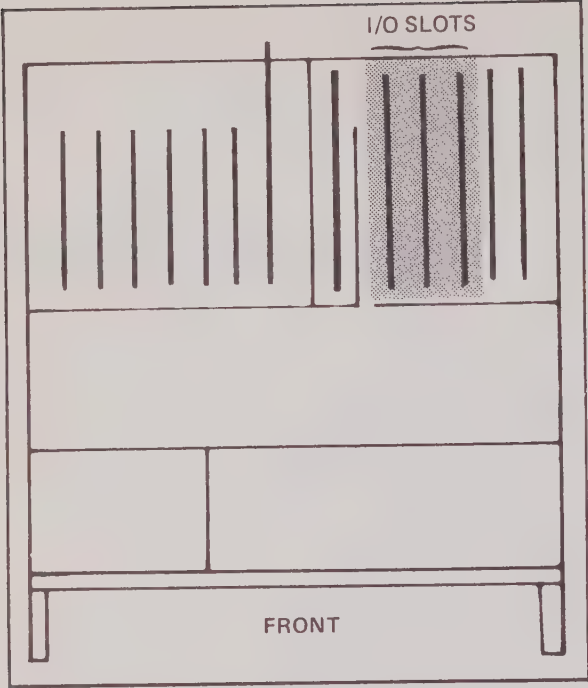


Figure 623-1. Alarm Set-Point Output, Installation Locations

623-9. OPERATION

623-10. Once installed in the data logger, the Alarm Set Point Output requires no operator attention. However, certain considerations are necessary to properly access and utilize the alarm outputs. These considerations are covered in the following paragraphs.

623-11. Interface Connections

623-12. Remote connections to the Alarm Set Point Output PCB are completed through either a General Purpose Interface Cable (2200A-7006) or a blank Interface Connector (2200A-7007). Either the cable or connector attaches to the Alarm Set Output PCB connector at the rear of the data logger. Both the cable and connector are available as accessories and are described earlier in this section (Section 6).

623-13. The user is responsible for completing the cable connections between the output connector and the remote input device. The pin connections of the Alarm Set Point Output's rear panel connector are given in Table 623-2, for both the 2200B and the 2240B.

Table 623-2. Option -23, I/O Connector Pin Assignments

PIN	SIGNAL			PIN	SIGNAL		
	2240B		2200B		2240B		2200B
1		15		26		30	
2		14		27		29	
3		13		28		28	
4		12		29		27	
5		11	ALARM	30		26	
6		10	CHANNEL or BLOCK	31		25	
7		9	9-99	32		24	
8	ALARMS	8	8	33	ALARMS	23	
9		7	7	34		22	
10		6	6	35		21	ALARM
11		5	5	36		20	LIMIT NUMBER
12		4	4	37		19	4
13		3	3	38		18	3
14		2	2	39		17	2
15		1	1	40		16	1
16		0	0	41	Logic Common (unguarded)		
17	Logic Common (Unguarded)			42	N/C		
18	N/C			43	N/C		
19	External Reset			44	Relay 4 (Spare for contact)		
20	Relay 4 (Spare for contact)			45	N/C		
21	N/C			46	Relay 3 (Spare for contact)		
22	Relay 3 (Spare for contact)			47	N/C		
23	N/C			48	Relay 2 (contact)		
24	Relay 2 (contact)			49	N/C		
25	N/C			50	Relay 1 (contact)		
	Relay 1 (contact)						

623-14. Alarm Outputs

623-15. The alarm outputs are driven by 30 separate open-collector transistors. When a channel measurement exceeds the value of its assigned limit, the corresponding transistor turns-on and pulls the appropriate alarm output to logic common. The output is held low until it is either manually or externally reset. Each open-collector output is capable of sinking a maximum of 30 mA when turned on. The maximum VCE, when off, is +25V dc. Power dissipation is 180 mW, maximum.

CAUTION

Use an external, isolated power supply to power devices driven by the alarm outputs.

623-16. The open-collector alarm outputs can be used to drive TTL/CMOS logic, LED's and/or relays. The recommended interface for each of these devices is shown in Figure 623-2. Notice that an external voltage supply must be used to drive the interface devices. This source should provide an isolated output so that its low terminal can be referenced to the data logger's logic common

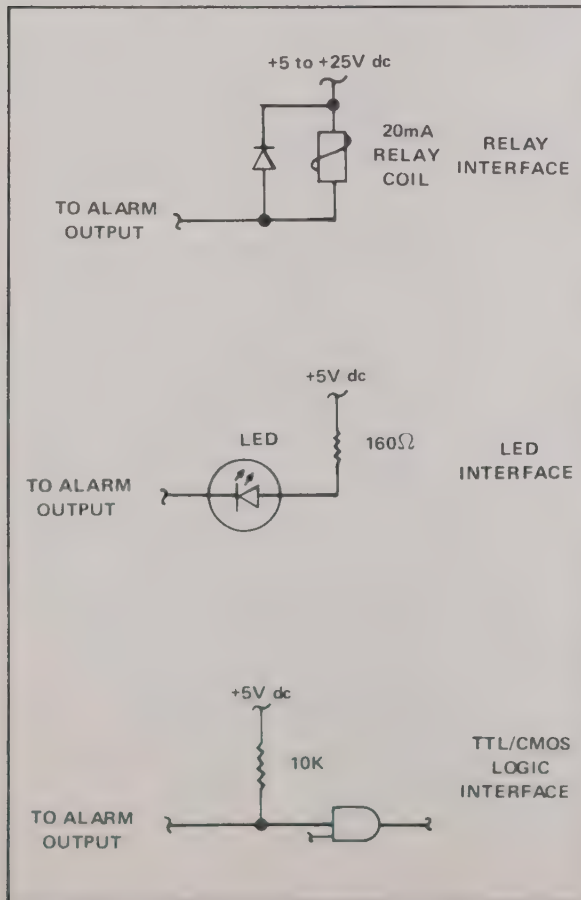


Figure 623-2. Recommended Output Alarm Interfaces

(unguarded). Otherwise a ground loop will result. A fuse is provided on the Alarm Set Point Output PCB to prevent possible damage in the event of ground loop currents. Fuse replacement details are given later under maintenance.

623-17. External Reset

623-18. The External Reset input responds to a low input supplied by a contact closure to logic common, or a low TTL logic level. The reset command must be equal to or exceed 2 μ s. A continuously low reset input holds 30 alarm transistors off regardless of the inputs from the data logger. When the reset is returned high, the alarm transistors are again allowed to respond to alarm data. This function allows a simple control loop to be established using the alarm output as a command and the reset as a response to clear the command. The next scan of the data logger will determine if the command needs to be sent again.

623-19. Alarm Relays

623-20. Two alarm relays, K1 and K2, are provided on the Alarm Set Point Output PCB. Normally, the relays are uncommitted. However, they can be assigned by the user to operate with any combination of alarm outputs. The assignments are made by installing a series of jumpers in the spaces provided on the pcb. Figure 623-3 defines the jumper locations. The square land patterns are numbered 1 through 30 and are common to the individual open collector outputs, 1 through 30. The round land patterns are common to the K1 and K2 control buses.

623-21. When jumper wires are installed, the collectors are tied to the relay buses in a wired OR configuration. See Figure 623-4A. Therefore, when either relay is operated, all alarm outputs common to the relay bus go low. If it is desirable to maintain the integrity of the individual alarm outputs while operating the control relays, install diodes in place of the jumper wires. See Figure 623-4B.

623-22. Circuitry is included on the Alarm Set Point Output PCB for the addition of two form-A, reed relays (K3 and K4), and their associated suppression diodes (CR3 and CR4). The I/O pin assignments for the K3 and K4 contacts are given in Table 623-2. The details necessary to install both relays are shown in Figure 623-5. The relay coils, reed switches and suppression diodes are available from the John Fluke Mfg. Co., Inc. Use the following part numbers when ordering:

1. Relay Coil	288357
2. Reed Switch	413294
3. Suppression Diode	203323

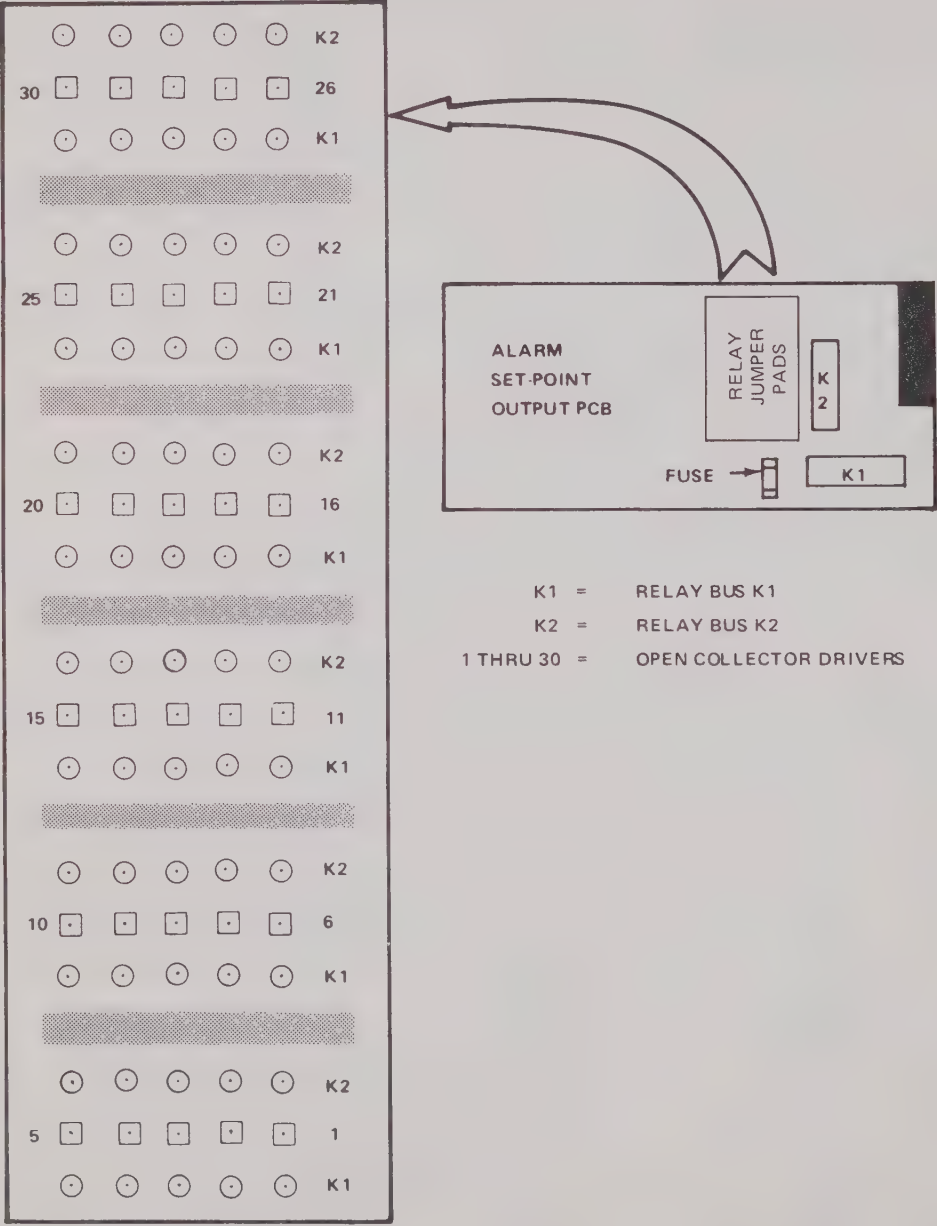


Figure 623-3. Alarm Set-Point Output PCB, Collector-to-Relay-Bus Jumper Locations

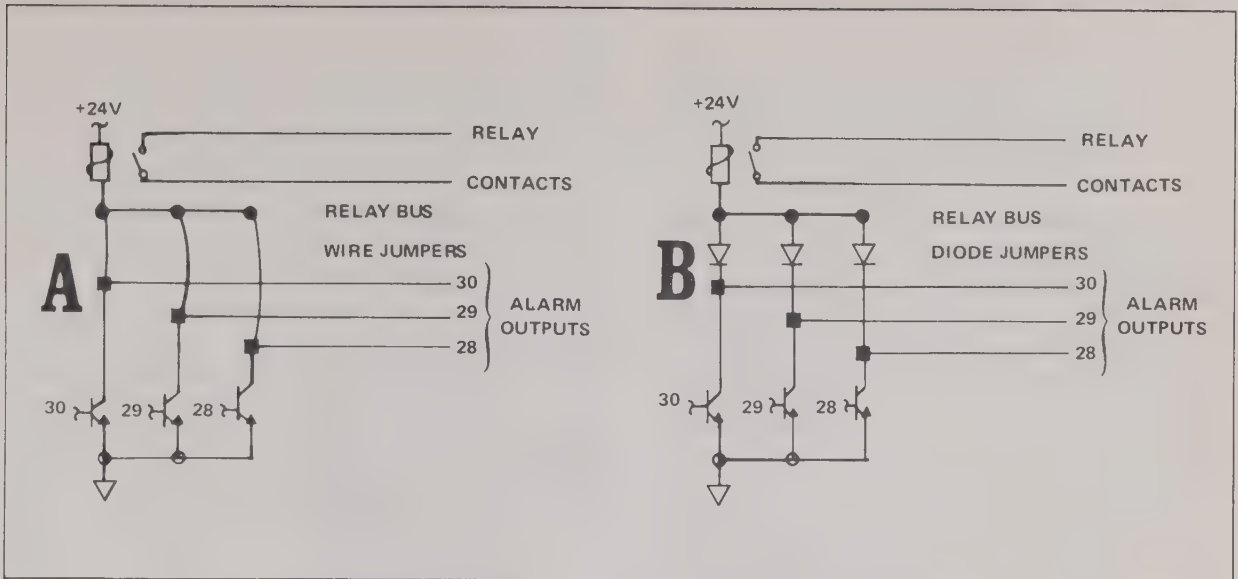


Figure 623-4. Collector-to-Relay-Bus Jumper Configurations

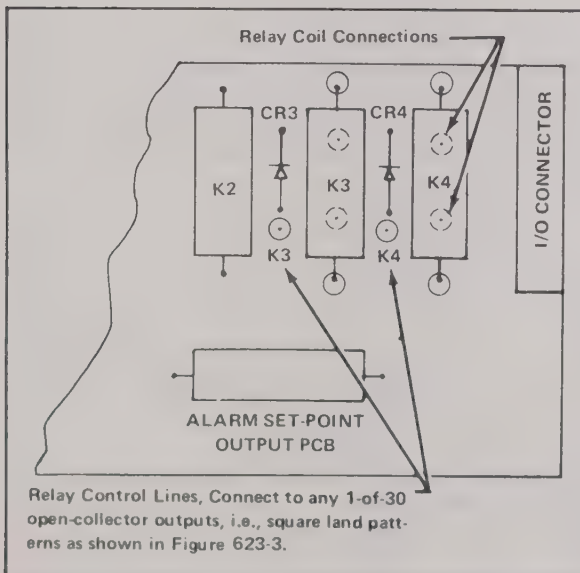


Figure 623-5. Locations for Mounting Reed Relays K3 and K4

623-23. THEORY OF OPERATION

623-24. The Alarm Set Point Output PCB, as shown in Figure 623-6, functions as a remote data interface to provide high/low limit information to external indicators/devices. Limit exceeded indications from the pcb are in the form of open-collector transistors and relay contacts. Thirty transistor outputs and two relay outputs are provided. Jumper pads on the pcb allow the user to

connect the two relay coils to any combination of the output transistors.

623-25. After the data logger completes each channel measurement, it compares the measured value with the assigned limit values, if any, for that channel. If the measured value falls within the assigned limit values, no action is taken at the Alarm Set Point Output PCB. However, if an out-of-limits indication is detected, the Controller addresses the Alarm Set Point Output PCB via the Control Bus and provides it with the failed limit address. A corresponding address register on the pcb stores the limit indication and, thereby, turns-on the appropriate output transistor as a limit exceeded indication.

623-26. Limit exceeded indications are supplied to the Alarm Set Point Output PCB as a maximum of two successive binary coded characters (0 through 15). The first character represents limit outputs 1 through 15 and the second represents limit outputs 16 through 30. If the exceeded limit is from group 16 through 30, the first character received on the Data Bus will be a binary zero (0000). A Strobe 1 pulse (derived from the out strobe) is generated by the control logic causing the zero to be entered into a 4-bit latch and decoder. Prior to the next Out strobe a Sync pulse occurs causing the control logic to generate an Inhibit 1 pulse. This pulse allows the decoder to read the 4-bit latch and enable the appropriate output (1-of-16); in this case 0 (zero). Normally, a decoder output of 1 through 15 would set 1 of the 15 R-S latches assigned to group 1 through 15. However, since the output is 0 (zero), all of the latches remain in their reset state.

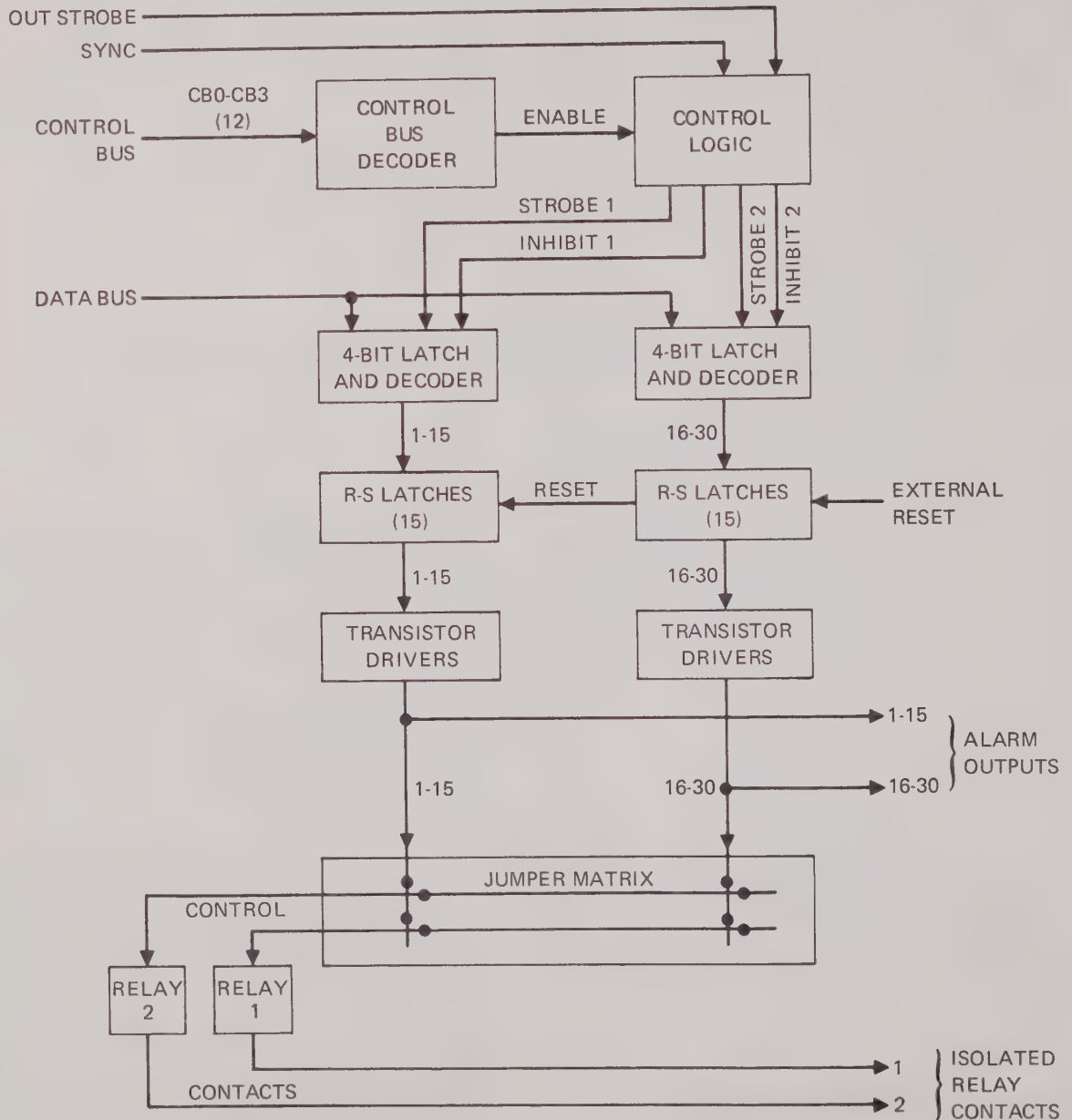


Figure 623-6. Alarm Set Point Output PCB, Simplified Block Diagram

623-27. The second address character is placed onto the Data Bus when the next Out strobe occurs. As before a strobe pulse (Strobe 2) is generated by the control logic and the limit address is entered into a 4-bit latch and decoder. On the following Sync pulse the resulting Inhibit 2 pulse enables the decoded output (representing outputs 16 through 30) allowing it to set the corresponding R-S latch. The set-latch turns-on the appropriate transistor driver to generate an alarm output.

623-28. When the limit exceeded indication is in the 1 through 15 output group the Controller supplies only one character rather than two, as previously described. This is necessary since a zero entered into the 16 through 30 output section represents a reset for all 30 R-S latches. Reset occurs when the front panel RESET/ALARM RESET switch is pressed or when an external reset is entered at the Alarm Set Point Output PCB.

623-29. MAINTENANCE

623-30. Access Information

623-31. Refer to the installation instructions given in paragraph 623-6 for Alarm Set Point Output PCB access information. Remove the rear panel output connector before attempting to remove the pcb from the data logger.

623-32. Fuse Replacement

623-33. A 1/2 amp, fast-acting fuse is located on the component side of the Alarm Set Point Output PCB Assembly. If replacement is necessary, pull out the old fuse from the fuse-clip and press a new one into place.

623-34. Performance Test

623-35. The Alarm Set Point Output PCB Assembly is most easily tested under normal operating conditions. That is, installed in a functional data logger and connected to the output devices it normally drives. Each alarm output can then be checked for pass or fail indications by limit-address and limit-value programming. Use the MONITOR scan control mode to ensure constant observation of the channel to which the limit address in question is assigned. Also be sure to reset the Alarm Output PCB when a limit is exceeded (see Internal Reset earlier in this subsection).

623-36. LIST OF REPLACEABLE PARTS

623-37. A list of replaceable parts for the Alarm Set Point Output Option is given in Table 623-3. Refer to Section 5 of this manual for ordering information.

CAUTION



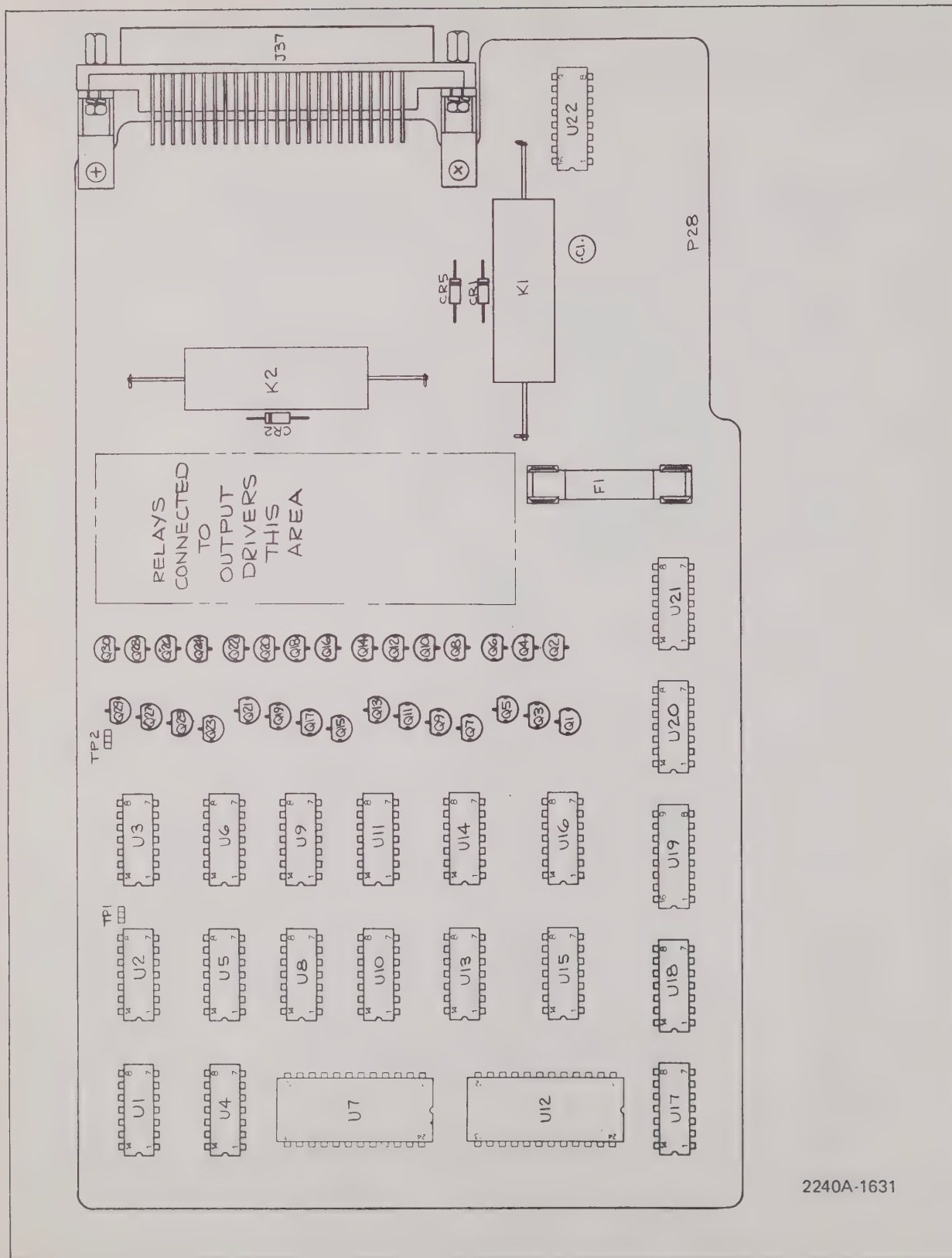
Indicated devices are subject to damage by static discharge.

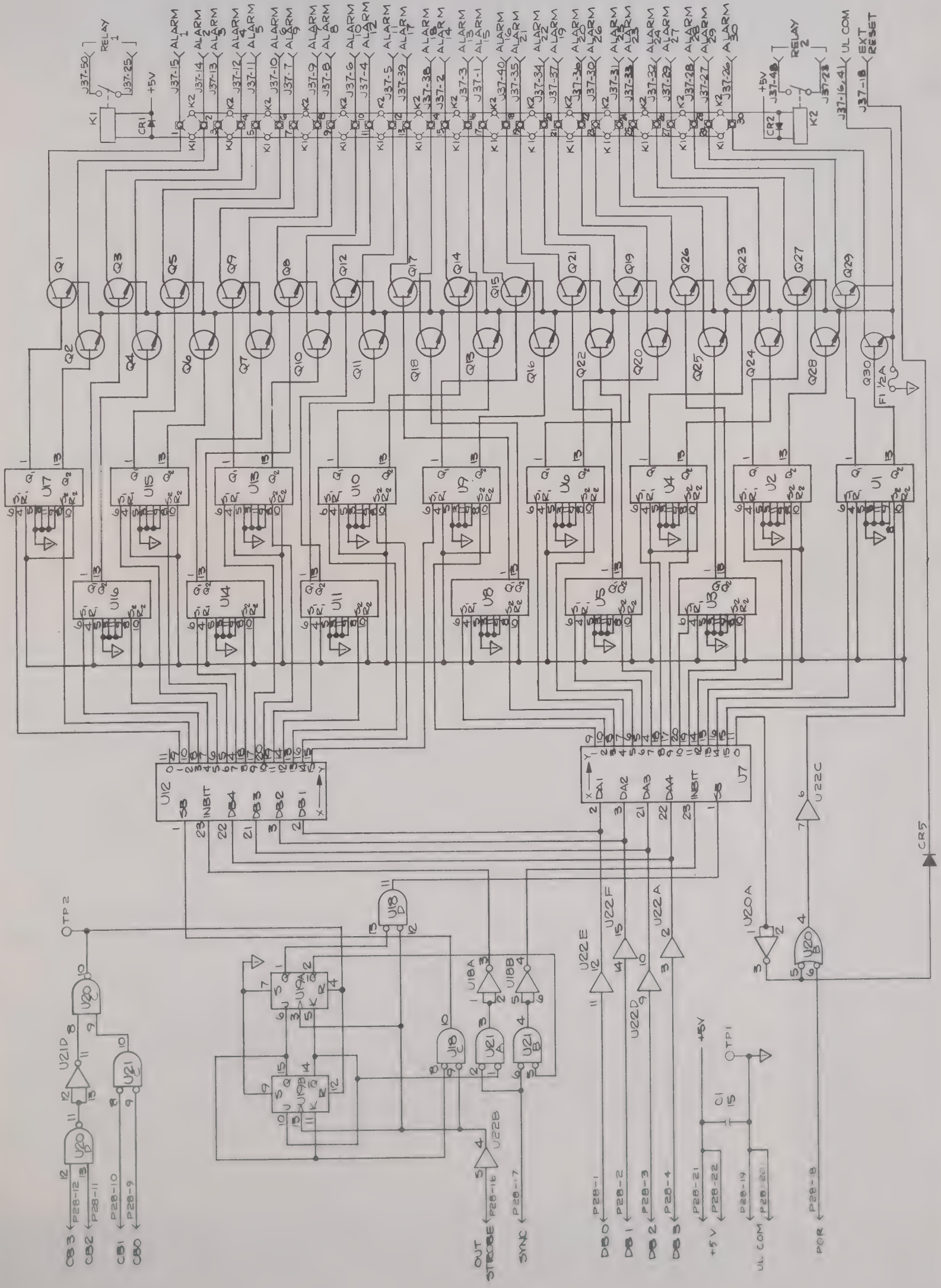
Table 623-3. Alarm Set Point Output PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
⊗ALARM SET POINT OUTPUT PCB ASSY OPT.-23							
FIGURE 623-7							
C1	CAP, TA, 10 UF +/-20%, 10V	176214	56218	196D106X0010KA1	1		
CR1	DIODE, HI-SPEED SWITCHING	203323	07910	1N4448	3		1
CR2	DIODE, HI-SPEED SWITCHING	203323	07910	1N4448	REF		
CR5	DIODE, HI-SPEED SWITCHING	203323	07910	1N4448	REF		
F1	FUSE, 1/2 AMP	153858	71400	AGC1-2	1		5
H1	WASHER, SPLIT LOCK #4	110395	73734	1355	2		
H2	NUT, 4-40	147611	89536	147611	2		
H3	SCREW, PHP, 4-40 X 3/8	152124	89536	152124	2		
H4	CONNECTOR, HARDWARE KIT	448563	00779	552565-2	1		
J37	CONNECTOR, PCB MOUNTING	414417	00779	552130-1	1		
K1-K2	RELAY ASSEMBLY						
	COIL, REED RELAY	288357	71707	SP-6-P	2		
	SWITCH, REED	413294	89536	413294	2		
Q1	XSTR, SI, NPN	330803	07263	MPS6560	30		6
Q2	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q3	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q4	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q5	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q6	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q7	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q8	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q9	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q10	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q11	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q12	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q13	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q14	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q15	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q16	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q17	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q18	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q19	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q20	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q21	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q22	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q23	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q24	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q25	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q26	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q27	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q28	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q29	XSTR, SI, NPN	330803	07263	MPS6560	REF		
Q30	XSTR, SI, NPN	330803	07263	MPS6560	REF		
TP1-TP2	CONNECTOR POST	267500	00779	87022-1	2		1
U1	⊗ IC, C-MOS, DUAL D TYPE FLIP-FLOP	340117	04713	MC14013CL	15		3
U2	⊗ IC, C-MOS, DUAL D TYPE FLIP-FLOP	340117	04713	MC14013CL	REF		
U3	⊗ IC, C-MOS, DUAL D TYPE FLIP-FLOP	340117	04713	MC14013CL	REF		
U4	⊗ IC, C-MOS, DUAL D TYPE FLIP-FLOP	340117	04713	MC14013CL	REF		

Table 623-3. Alarm Set Point Output PCB Assembly (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U5	⊗ IC, C-MOS, DUAL D TYPE FLIP-FLOP	340117	04713	MC14013CL	REF		
U6	⊗ IC, C-MOS, DUAL D TYPE FLIP-FLOP	340117	04713	MC14013CL	REF		
U7	⊗ IC, C-MOS, 4-BIT LATCH/4-TO-16 LINE DCDR	414342	18725	C04514BE	2		1
U8	⊗ IC, C-MOS, DUAL D TYPE FLIP-FLOP	340117	04713	MC14013CL	REF		
U9	⊗ IC, C-MOS, DUAL D TYPE FLIP-FLOP	340117	04713	MC14013CL	REF		
U10	⊗ IC, C-MOS, DUAL D TYPE FLIP-FLOP	340117	04713	MC14013CL	REF		
U11	⊗ IC, C-MOS, DUAL D TYPE FLIP-FLOP	340117	04713	MC14013CL	REF		
U12	⊗ IC, C-MOS, 4-BIT LATCH/4-TO-16 LINE DCDR	414342	18725	C04514BE	REF		
U13	⊗ IC, C-MOS, DUAL D TYPE FLIP-FLOP	340117	04713	MC14013CL	REF		
U14	⊗ IC, C-MOS, DUAL D TYPE FLIP-FLOP	340117	04713	MC14013CL	REF		
U15	⊗ IC, C-MOS, DUAL D TYPE FLIP-FLOP	340117	04713	MC14013CL	REF		
U16	⊗ IC, C-MOS, DUAL D TYPE FLIP-FLOP	340117	04713	MC14013CL	REF		
U17	⊗ IC, C-MOS, DUAL D TYPE FLIP-FLOP	340117	04713	MC14013CL	REF		
U18	⊗ IC, C-MOS, 2-INPUT NOR GATE	355172	04713	MC14001CP	2		1
U19	⊗ IC, C-MOS, DUAL J-K FLIP-FLOP	355230	04713	MC14027BCP	1		1
U20	⊗ IC, C-MOS, QUAD 2-INPUT NAND GATE	355198	04713	MC14011CP	1		1
U21	⊗ IC, C-MOS, 2-INPUT NOR GATE	355172	04713	MC14001CP	REF		
U22	⊗ IC, C-MOS, HEX BUFFER/CONVERTER	355412	04713	MC14010CP	1		1





NOTES:
1. UNLESS OTHERWISE SPECIFIED
ALL CAPACITANCES ARE IN
MICROFARADS.
2. ALL GRAPHIC SYMBOLS ARE IN
ACCORDANCE WITH ANSI Y32.2
& Y32.14.
3. ▽ DENOTES UNGUARDED LOGIC
COMMON (UL COM)

IC DES.	PIN NO.	UL COM
U1	14	7
U2	14	7
U3	14	7
U4	14	7
U5	14	7
U6	14	7
U7	16	8
U8	14	7
U9	14	7
U10	14	7
U11	16	8
U12	14	7
U13	14	7
U14	14	7
U15	14	7
U16	14	7
U17	14	7
U18	16	8
U19	14	7
U20	14	7
U21	14	7
U22	1,16	8

2240A-1031

Figure 623-7. Alarm Set Point Output PCB
Assembly (cont)

Option —25 Temperature and Single Scaling

625-1. INTRODUCTION

625-2. The basic Model 2240B Data Logger measures, records and displays channel input data in terms of dc voltage. Depending on the range selected, the data is displayed in either millivolts or volts. Analog input signals produced by external transducers, however, may represent any physical or electrical parameter such as pressure, temperature, flow, strain, etc. If proper signal conditioning and the appropriate scaling option are used, the data logger will measure, scale and record data directly in the proper engineering units, e.g., °C, °F, psi, %, etc. Compatible transducers include thermocouples, thermistors, resistance temperature detectors (RTD's) or any device whose output is a dc voltage (1 μ V to 40V) or dc current. Measuring, recording and displaying data directly in terms of the transducer measurement unit requires adding one or more of the available scaling options to the data logger as shown in Table 625-1. Other scaling options, —11, —26, and —27, are described in detail, when applicable, in Section 6 of the data logger manual.

625-3. DESCRIPTION

625-4. The —25 Temperature and Single Scaling Option, operating in place of the —11 Temperature and Current Transmitter Option, allows the customer to specify one custom scaling for data logger inputs from transducers other than those in Table 625-1. Scaling is accomplished by means of a custom programmed PROM containing all data used by the linearization program in the data logger.

625-5. The —25 Temperature and Single Scaling Option consists of an analog temperature pcb which attaches to the A/D Converter; a linearization ROM which contains the linearization program for the micro-processor; linearization tables for the J, K, T, R, and S thermocouple types; and a configuration PROM, which relates front panel programming via data entry keys T1, T2, T3, and T4 to the proper linearization table, A/D converter range and engineering units. The ROM plugs into the Controller PCB. Refer to Section 611 of the data logger manual for a detailed description of the —11 Temperature Option.

625-6. The custom scaling PROM included in the —25 Option augments the standard linearization ROM to provide linear scaling for any customer supplied data. If the data logger is equipped with the —25 Option, the PROM will be located on the Controller PCB at location U11. The configuration PROM (U12), on the Controller PCB will be programmed to reflect the presence of the —25 Option in the system with respect to A/D converter range, decimal point location and actual program locations relative to front panel data entry functions, T1, T2, T3, and T4.

625-7. SPECIFICATIONS

625-8. The —25 Option provides one custom scaling program and three temperature programs as specified in Table 625-1. Basic data logger and option specifications are unchanged with the inclusion of this option. Refer to Sections 1 and 6 for complete data logger and data logger option specifications.

625-9. PROGRAM DEFINITION

625-10. The custom scaling program provided with the —25 Option is designed and developed from application information supplied by the customer at time of purchase. This information consists of the data for the two end points on the measurement scale. All actual inputs must be between these two points. The input in dc volts must be specified for these two End Points, including decimal location and polarity. The corresponding reading for each of these input points must also be specified. It should be noted that a reading cannot exceed 39999. If notation of measurement units is required in the readout, e.g., psi or kg, Option —27, Engineering Units Notation must be employed.

625-11. Following are examples of customer supplied application data in proper format to enable development of a custom scaling.

Example:

		T4	T3	T2	T1
1st End Point	Input	−2.0V	J-type thermocouple	K-type thermocouple	T-type thermocouple
	Reading	100V			
2nd End Point	Input	−10.0V			
	Reading	400V			

NOTE: Proper reading will be obtained only for inputs between End Points, e.g., between −2.0V and −10.0V on T1.

625-12. OPERATING INSTRUCTIONS

625-13. Operating instructions for data loggers equipped with the —25 Option are the same as for the standard data logger with the addition of the customer specified T1, T2, T3, and T4 front panel functions. These functions will be designated by special markings on the front panel

Table 625-1. Data Logger Measurement and Scaling Options

OPTION	COMPATIBLE TRANSDUCERS			READOUT	FACTORY INSTALLED OPTION ONLY	REMARKS
	Thermocouples	RTD's	Current Transmitters			
2240B-11 Temperature and Current Transmitter Option	J, K, T, R, S, E, B, C, G, D (W3, J-DIN, K-DIN, S-DIN, T-DIN	385 Platinum 392 Platinum	1-5 mA, 4-20 mA, 10-50 mA Scaled 0 to 100%	Thermocouples and RTD's in °C or °F, Current Transmitters in %	Yes	Provides up to four trans- ducer inputs (T1 thru T4) selected in any combination. °C or °F selected by a switch on the Controller PCB. Readout in units other than % for Current Transmitters or °C/°F for temperature requires addition of Option —27.
2240B-25 Temperature and Single Scaling Option	Any three J, K, T, R, or S thermocouple, plus one custom transducer with an output in the range of 1 μV to 40V dc or current (when using Options —28, —29, or —30).			As specified by customer	Yes	Provides one custom linear scaling for transducer input specified by the customer.
2240B-26 Multiple Scaling Option	Up to four custom scalings, AX+B type			As specified by customer.	Yes	Provides up to four scalings (T1 thru T4) of AX+B type, as specified by customer. Option —11 must be installed in the data logger if thermocouple scales are included.
2240B-27 Engineer Units Notation	Notation only for T1 thru T4			As selected by customer.	Yes	Provides choice of printer notation, combining one from Column 17 plus one from Column 18: Column 17 Column 18 DC °F V si AC dB ohm F k μ (micro) lb W M G Hz A m (blank) s (blank) p kg c ² mA °C (blank) % (blank)

to indicate which function will be called when the corresponding function button is pressed. Refer to Section 2 for complete data logger operating instructions.

625-14. THEORY OF OPERATION

625-15. The basic theory of operation of the data logger is unchanged with inclusion of the —25 Option.

625-16. When a —25 Option is added to a data logger, the standard linearization ROM, (U5), located on the Controller PCB, is augmented by the custom scaling PROM (U11). The configuration PROM, U12 located on the Controller PCB, is programmed to accommodate the —25 Option PROM.

625-17. MAINTENANCE

625-18. Standard data logger maintenance procedures apply to data loggers equipped with the —25 Option. Refer to Section 4 of the data logger manual for complete maintenance information.



U11 and U12 are subject to damage by static discharge.

Option —26 Multiple Scaling

626-1. INTRODUCTION

626-2. The basic Model 2240B Data Logger measures, records and displays channel input data in terms of dc voltage. Depending on the range selected, the data is displayed in either millivolts or volts. Analog input signals produced by external transducers, however, may represent any physical or electrical parameter such as pressure, temperature, flow, strain, etc. If proper signal conditioning and the appropriate scaling option are used, the data logger will measure, scale and record data directly in the proper engineering units, e.g., °C, °F, psi, %, etc. Compatible transducers include thermocouples, thermistors, resistance temperature detectors (RTD's) or any device whose output is a dc voltage (1 μ V to 40V) or dc current. Measuring, recording and displaying data directly in terms of the transducer measurement unit requires adding one or more of the available scaling options to the 2240B Data Logger as shown in Table 626-1. The —11, —25 and —27 options are described in detail in separate pages of the options section in this manual.

626-3. The —11 Temperature and Current Transmitter Option consists of an analog temperature pcb which attaches to the A/D Converter; a linearization ROM which contains the linearization program for the micro-processor; linearization tables for the J, K, R, S, T, E, B, C, G, and D (W3) thermocouple types; and a configuration PROM, which relates front panel programming via data entry keys T1, T2, T3, and T4 to the proper linearization table, A/D converter range, and engineering units. (An optional PROM may be used when other thermocouples, RTD's, or current transmitters are used.) The PROM or ROM plugs into the Controller PCB. Refer to Section 6 of the data logger manual for detailed information including specifications, operating instructions, theory of operation and maintenance, for the —11 Temperature and Current Transmitter Option.

626-4. DESCRIPTION

626-5. The —26 Multiple Scaling Option is a plug-in option that operates similar to the —11 Temperature and Current Transmitter Option. Basically, the Multiple Scaling Option allows selection of more than one custom scaling program. If one or more of the "T" functions are for thermocouples, the data logger must be equipped with the —11 Option. Depending on customer selection at time of purchase, the —26 Option provides up to four scalings per data logger in any combination.

626-6. Implementation of multiple scaling programs is accomplished by replacing the linearization ROM in the Controller with a more flexible PROM assembly. If notation of measurement units other than % for current transmitters or °C or °F for temperature is desired, the data logger must also be equipped with the —27 Engineering Units Notation Option. Refer to Section 6 of the data logger manual for detailed information concerning the —27 Option.

626-7. SPECIFICATIONS

626-8. The —26 Multiple Scaling Option consists of AX+B scaling programs selected by the customer. Points to be specified for these scalings are: input reading at low end of scale and input reading at high end of scale. Basic data logger specifications are unchanged with the inclusion of this option. Refer to Sections 1 and 6 for complete data logger and data logger option specifications.

626-9. OPERATING INSTRUCTIONS

626-10. Operating instructions for data loggers equipped with the —26 Multiple Scaling Option are the same as for the standard data logger with the addition of the customer specified T1, T2, T3, and T4 front panel functions. These functions will be designated by special markings on the front panel to indicate which linearization will be called when the corresponding function button is pressed. Refer to Section 2 for complete data logger operating instructions.

626-11. MAINTENANCE ACCESS

626-12. The Multiple Scaling PROM is located on the Controller PCB. To gain access to the PROM assembly for service or replacement, proceed as follows:

- a. Turn data logger power OFF.

- b. Remove the top dust cover.
- c. Remove the screws securing the top right rear guard cover.
- d. Remove the Controller PCB Assembly. IC U5 is the Multiple Scaling PROM. In some scaling configurations IC U11 may also be present.



CAUTION

U5 and U11 are subject to damage by static discharge.

626-13. LIST OF REPLACEABLE PARTS

626-14. IC's U11 and/or U5 are programmed and labeled in accordance with customer specifications. When replacement is necessary special markings from the original part must accompany the order for these parts.

Table 626-1. Data Logger Measurement and Scaling Options

OPTION	COMPATIBLE TRANSDUCERS			READOUT	FACTORY INSTALLED OPTION ONLY	REMARKS																																
	Thermocouples	RTD's	Current Transmitters																																			
2240B-11 Temperature and Current Transmitter Option	J, K, T, R, S, E, B, C, G, D (W3, J-DIN, K-DIN, S-DIN, T-DIN	385 Platinum 392 Platinum	1-5 mA, 4-20 mA, 10-50 mA Scaled 0 to 100%	Thermocouples and RTD's in °C or °F, Current Transmitters in %	Yes	Provides up to four trans- ducer inputs (T1 thru T4) selected in any combination. °C or °F selected by a switch on the Controller PCB. Readout in units other than % for Current Transmitters or °C/°F for temperature requires addition of Option —27.																																
2240B-25 Temperature and Single Scaling Option	Any three J, K, T, R, or S thermocouple, plus one custom transducer with an output in the range of 1 μV to 40V dc or current (when using Options —28, —29, or —30).			As specified by customer	Yes	Provides one custom linear scaling for transducer input specified by the customer.																																
2240B-26 Multiple Scaling Option	Up to four custom scalings, AX+B type			As specified by customer.	Yes	Provides up to four scalings (T1 thru T4) of AX+B type, as specified by customer. Option —11 must be installed in the data logger if thermocouple scales are included.																																
2240B-27 Engineer Units Notation	Notation only for T1 thru T4			As selected by customer.	Yes	Provides choice of printer notation, combining one from Column 17 plus one from Column 18: <table><tr><th colspan="2">Column 17</th><th colspan="2">Column 18</th></tr><tr><td>DC</td><td>°F</td><td>V</td><td>si</td></tr><tr><td>AC</td><td>dB</td><td>ohm</td><td>F</td></tr><tr><td>k</td><td>μ (micro)</td><td>lb</td><td>W</td></tr><tr><td>M</td><td>G</td><td>Hz</td><td>A</td></tr><tr><td>m</td><td>(blank)</td><td>s</td><td>(blank)</td></tr><tr><td>p</td><td>kg</td><td>c²</td><td>mA</td></tr><tr><td>°C</td><td>(blank)</td><td>%</td><td>(blank)</td></tr></table>	Column 17		Column 18		DC	°F	V	si	AC	dB	ohm	F	k	μ (micro)	lb	W	M	G	Hz	A	m	(blank)	s	(blank)	p	kg	c ²	mA	°C	(blank)	%	(blank)
Column 17		Column 18																																				
DC	°F	V	si																																			
AC	dB	ohm	F																																			
k	μ (micro)	lb	W																																			
M	G	Hz	A																																			
m	(blank)	s	(blank)																																			
p	kg	c ²	mA																																			
°C	(blank)	%	(blank)																																			

Option —27 Engineering Units Notation

627-1. INTRODUCTION

627-2. The basic Model 2240B Data Logger measures, records, and displays channel input data in terms of dc voltage. Depending on the range selected, the data is displayed in either millivolts or volts. Analog input signals produced by external transducers, however, may represent any physical or electrical parameter such as pressure, temperature, flow, strain, etc. If proper signal conditioning and the appropriate scaling options are used, the data logger will measure, scale and record data directly in the proper engineering units, e.g., °C, °F, psi, %, etc. Compatible transducers include thermocouples, thermistors, resistance temperature detectors (RTD's) or any device whose output is a dc voltage (1 μ V to 40V) or dc current. Measuring, recording and displaying data directly in terms of the transducer measurement unit requires adding one or more of the available scaling options to the 2240B Data Logger as shown in Table 627-1.

627-3. The —11 Temperature and Current Transmitter Option consists of an analog temperature pcb which attaches to the A/D Converter; a linearization ROM which contains the linearization program for the microprocessor; linearization tables for the various thermocouple types; an optional PROM which contains linearization tables for RTD's and current transmitters, and/or type E, B, C, G, and D thermocouples; and a configuration PROM which relates front panel programming via data entry keys T1, T2, T3 and T4 to the proper linearization table, A/D converter range and engineering units.

627-4. The —25 Custom Scaling Option, operating in place of the —11 Temperature and Current Transmitter Option, allows the customer to specify one custom scaling for data logger inputs from transducers other than the J, K, T, R, S thermocouples.

627-5. The —26 Multiple Scaling Option is a plug-in option that operates similar to the —25 Option. Basically, the Multiple Scaling Option allows selection of more than one custom scaling table. Depending on customer selection at time of purchase, the —26 Option provides up to four $AX+B$ scalings per data logger in any combination.

627-6. Refer to Section 6 of the data logger manual for detailed information including specifications, operating instructions, theory of operation and maintenance, for the —11 Temperature and Current Transmitter Option, —25 Temperature and Single Scaling Option, and —26 Multiple Scaling Option.

627-7. DESCRIPTION

627-8. The —27 Engineering Units Notation Option allows customer choice of display annunciator, decimal point position and printer annunciator for data logger front panel functions T1, T2, T3 and T4. The Engineering Unit Notation Option applies only to actual units notation, such as mV, mA, psi and %, and not to any scaling or changing of numbers. If the application requires converting or scaling a transducer input voltage (to the data logger) to read out directly in the desired transducer units, the —11, —25, or —26 Options would also be required along with the —27 Option.

627-9. For example, if a transducer provides a 0 to 200 mV output for a 0 to 1000 psi input, Option —27 (Engineering Units Notation) could merely change the mV to psi on the assigned "T" function. If exact correlation is required (i.e., 200 mV in reads 1000 psi) scaling is necessary. Either the —25 or —26 Options, along with the —27 Option would be used to provide the scaling to change 200 mV to 1000 psi.

627-10. SELECTION OF ENGINEERING UNITS NOTATION

627-11. Specifying Engineering Units Notation involves several considerations, including selection of desired units, selection of decimal point location for both display and printout, selection of display annunciator and selection of A/D converter range, depending on the particular data logger application.

627-12. If the Engineering Units Notation Option is to be used without the —25 Temperature and Single Scaling Option (special custom scaling of the transducer input not required), the following steps are required to adequately define the —27 Option parameters for each data logger input requiring notation:

- a. Specify desired choice of notation, one from column 17 and one from column 18.

Column 17		Column 18	
DC	°F	V	si
AC	dB	ohm	F
k	μ	lb	W
M	G	Hz	A
m	(Blank)	s	(Blank)
p	kg	C ²	mA
°C	(Blank)	%	(Blank)

Examples: Column 17		Column 18	
m	+	W	= mW
Blank	+	mA	= mA
p	+	si	= psi

- b. Select Decimal Point Location:

1. xxxx.x
2. xxx.xx
3. xx.xxx
4. x.xxxx
5. xxxxx

- c. Select Display Annunciator

1. Temperature
2. Millivolts
3. Volts
4. Time
5. (Blank)

- d. Select Range

1. 40 mV
2. 400 mV
3. 4V
4. 40V.

NOTE: 40 mV and 40V ranges require the —10 High Performance A/D Converter Option.

- e. Select Front Panel Function location

1. T1
2. T2
3. T3
4. T4

627-13. If the Engineering Units Notation Option is to be used in conjunction with the —25 Option steps (b) through (d) should also be specified as part of the specification for the —25 Option.

627-14. SPECIFICATIONS

627-15. The —27 Engineering Units Notation Option is a custom function configuration program based on customer designated parameters. Basic data logger and data logger option specifications are unchanged with the inclusion of this option. Refer to Sections 1 and 6 for complete data logger specifications.

627-16. OPERATING INSTRUCTIONS

627-17. Operating instructions for data loggers equipped with the —27 option are the same as for the standard data logger with the addition of the customer specified T1, T2, T3 or T4 front panel functions. These functions will be designated by special markings on the front panel to indicate which units notation will be called when the corresponding function button is pressed. Refer to Section 2 for complete data logger operating instructions.

627-18. THEORY OF OPERATION

627-19. The basic theory of operation for the data logger is unchanged with the inclusion of the —27 Option. When the —27 Option is added to a data logger equipped with the —25 or —26 Options, the configuration PROM used will be programmed to reflect display annunciator, decimal point position and printer annunciator as specified by the customer. This PROM is used to characterize the functions T1, T2, T3, and T4. The configuration PROM, U12, is located on the Controller PCB.

627-20. Normally, Option —27 is not required when the data logger is equipped with Option —11. Notations of °C or °F are provided with Option —11.

627-21. MAINTENANCE

627-22. Standard data logger maintenance procedures apply to data loggers equipped with the —27 Engineering Units Notation Option. Refer to Section 5 of the data logger manual for complete maintenance information.

627-23. LIST OF REPLACEABLE PARTS

627-24. IC U12 is programmed and labeled in accordance with customer specifications. When replacement is necessary special markings from the original part must accompany the order.



CAUTION

IC U12 is subject to damage by static discharge.

Table 627-1. Data Logger Measurement and Scaling Options

OPTION	COMPATIBLE TRANSDUCERS			READOUT	FACTORY INSTALLED OPTION ONLY	REMARKS																																
	Thermocouples	RTD's	Current Transmitters																																			
2240B-11 Temperature and Current Transmitter Option	J, K, T, R, S, E, B, C, G, D (W3, J-DIN, K-DIN, S-DIN, T-DIN	385 Platinum 392 Platinum	1-5 mA, 4-20 mA, 10-50 mA Scaled 0 to 100%	Thermocouples and RTD's in °C or °F, Current Transmitters in %	Yes	Provides up to four trans- ducer inputs (T1 thru T4) selected in any combination. °C or °F selected by a switch on the Controller PCB. Readout in units other than % for Current Transmitters or °C/°F for temperature requires addition of Option —27.																																
2240B-25 Temperature and Single Scaling Option	Any three J, K, T, R, or S thermocouple, plus one custom transducer with an output in the range of 1 μV to 40V dc or current (when using Options —28, —29, or —30).			As specified by customer	Yes	Provides one custom linear scaling for transducer input specified by the customer.																																
2240B-26 Multiple Scaling Option	Up to four custom scalings, AX+B type			As specified by customer.	Yes	Provides up to four scalings (T1 thru T4) of AX+B type, as specified by customer. Option —11 must be installed in the data logger if thermocouple scales are included.																																
2240B-27 Engineer Units Notation	Notation only for T1 thru T4			As selected by customer.	Yes	Provides choice of printer notation, combining one from Column 17 plus one from Column 18: <table><tr><th colspan="2">Column 17</th><th colspan="2">Column 18</th></tr><tr><td>DC</td><td>°F</td><td>V</td><td>si</td></tr><tr><td>AC</td><td>dB</td><td>ohm</td><td>F</td></tr><tr><td>k</td><td>μ (micro)</td><td>lb</td><td>W</td></tr><tr><td>M</td><td>G</td><td>Hz</td><td>A</td></tr><tr><td>m</td><td>(blank)</td><td>s</td><td>(blank)</td></tr><tr><td>p</td><td>kg</td><td>c²</td><td>mA</td></tr><tr><td>°C</td><td>(blank)</td><td>%</td><td>(blank)</td></tr></table>	Column 17		Column 18		DC	°F	V	si	AC	dB	ohm	F	k	μ (micro)	lb	W	M	G	Hz	A	m	(blank)	s	(blank)	p	kg	c ²	mA	°C	(blank)	%	(blank)
Column 17		Column 18																																				
DC	°F	V	si																																			
AC	dB	ohm	F																																			
k	μ (micro)	lb	W																																			
M	G	Hz	A																																			
m	(blank)	s	(blank)																																			
p	kg	c ²	mA																																			
°C	(blank)	%	(blank)																																			

Option —28, —29, —30 Current Transmitter Connectors

628-1. INTRODUCTION

628-2. The Current Transmitter Connectors are card-edge connector assemblies designed for use in making dc current measurements. The connector assemblies are compatible with the General Purpose Scanner (2200A-05) and Low Level Scanner (2200A-06) and are intended for use with the Model 2240A Data Logger, Model 2201A Scanner Chassis, Model 2202A Remote Scanner Chassis, and Model 2203A RTD Scanner Chassis. The connector assemblies mount on the rear of the data logger or scanner chassis and provide input connections in the form of screw terminals.

628-3. DESCRIPTION

628-4. Current Transmitter Inputs

628-5. The Current Transmitter Connectors provide accuracy and convenience in handling the output of current transmitters with dc current ranges of 1 to 5 mA, 4 to 20 mA and 10 to 50 mA. The Current Transmitter Connectors accept the dc output current of the current transmitters and convert the current to a proportional dc voltage using precision shunt resistors. The dc voltage is then detected and displayed by the data logger. Up to 10 current transmitter inputs can be assigned to each Current Transmitter Connector.

628-6. With the exception of shunt resistor value, the Current Transmitter Connectors are identical in construction and operation. The 1 to 5 mA unit uses 60Ω shunt resistors, the 4 to 20 mA unit 15Ω shunt resistors and the 10 to 50 mA unit 6Ω shunt resistors. The Current Transmitter Connectors produce the same range of voltage readout on the data logger, i.e., 60 mV to 300 mV for 1 to 5 mA, 4 to 20 mA and 10 to 50 mA current transmitter inputs.

628-7. General Purpose Current Inputs

628-8. The current handling capability of the Current Transmitter Connectors is not limited to 5 mA, 20 mA, and 50 mA. These values simply designate the appropriate connector for current transmitter use. For general lab or production applications, the current range for each connector is limited only by the maximum power dissipation in the associated shunt resistors. Since the shunt resistors are all 1/4 watt units, the maximum working dc current ranges are as follows:

Current Transmitter Connector	Maximum Current Input	Corresponding Full Scale Data Logger Readout
1 to 5 mA	0 to 64.5 mA	3.87V
4 to 20 mA	0 to 129 mA	1.935V
10 to 50 mA	0 to 204 mA	1.224V

628-9. Current Transmitter Readout Options

628-10. The basic Model 2240A Data Logger measures, records and displays channel input data in terms of dc voltage. Depending on the range selected, the data is displayed in either millivolts or volts. Analog input signals, however, may represent any physical or electrical parameter such as pressure, temperature, flow, strain, voltage, current, etc. If proper signal conditioning and the appropriate scaling option are used, the data logger will measure, scale and record data in the proper engineering units, e.g., °C, °F, psi, %, etc. Compatible transducers include thermocouples, thermistors, resistance temperature detectors (RTD's) or any device whose output is a dc voltage (1 μV to 40V) or dc current. Measuring, recording and displaying data directly in terms of the transducer measurement unit requires one or more of the available scaling options.

628-11. Readout in Voltage

628-12. When the —28, —29 and —30 Current Transmitter Connectors are used in the basic data logger without adding any of the available Measurement and Scaling Options, the data logger will display and printout in dc volts and millivolts corresponding to current transmitter inputs.

628-13. Readout in Percent

628-14. Adding the —11 Temperature and Scaling Option provides the data logger with the capability of scaling current transmitter inputs to provide readings in percent. For example, using the —28, —29 or —30 Current Transmitter Connectors, a minimum (1 mA, 4 mA or 10 mA) current transmitter input would be displayed as 0% and a maximum (5 mA, 20 mA, 50 mA) input as 100%. The proper function and range for this application would be called by selecting the assigned front panel function, T1, T2, T3 or T4.

628-15. Readout in Other Engineering Units

628-16. If the data logging application required that current transmitter inputs be presented in measurement units other than percent, the data logger would have to be fitted with the —25 Custom Scaling Option and —27 Engineering Units Notation. The Custom Scaling Option provides the actual scaling necessary for readout in the desired measurement unit. Selection of units, provided by the Engineering Units Notation Option, offers customer choice of notation, one from Group 1 combined with one from Group 2, as follows:

Group 1

Group 2

1 - DC	8 - °F	1 - V	8 - Si
2 - AC	9 - dB	2 - ohm	9 - F
3 - k	10 - μ (micro)	3 - lb	10 - W
4 - M	11 - G	4 - Hz	11 - A
5 - m	120 (Blank)	5 - s	12 - (Blank)
6 - p	13 - kg	6 - c^2	13 - mA
7 - °C	14 - (Blank)	7 - %	14 - (Blank)

Example: No. 6 (Group 1) + No. 8 (Group 2) = psi

628-17. One custom scaling and units notation is provided for each —25 and —27 option added to the data logger to a maximum of four per data logger. Refer to the —25 and —27 option sections in Section 6 of this manual for detailed information about these options.

628-18. SPECIFICATIONS

628-19. See Table 628-1 for Current Transmitter Connector Specifications.

628-2

628-20. INPUT CONNECTIONS

628-21. Figure 628-1 shows the terminal assignments for the Current Transmitter Connectors. Access to the terminals is accomplished by removing the four screws from the decal side of the connector enclosure. The decal identifies the connector's input terminals which consist of HI, LO and Shield for each of the 10 channels. Connect external wires or cables to the desired channels. Best results are usually obtained using a 2-conductor shielded cable for each channel with the shield connected to the appropriate "SH" terminal at the connector and to source "LO" at the measurement source.

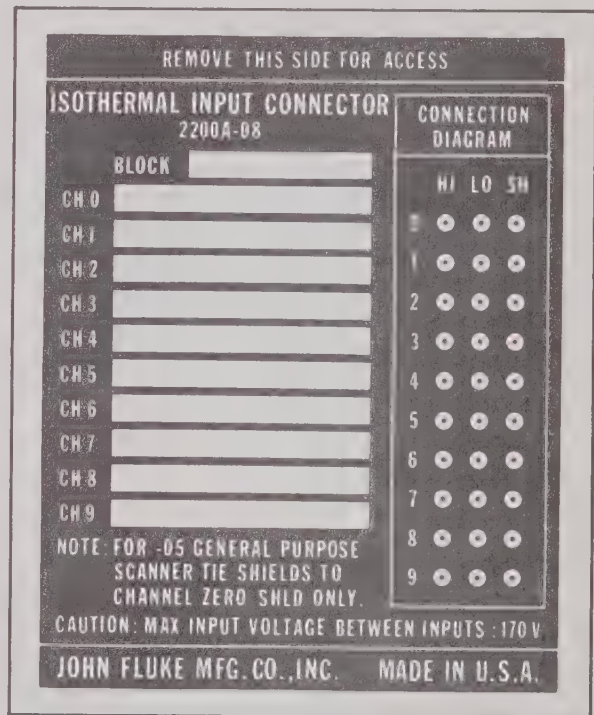


Figure 628-1.
Current Transmitter Connector Terminal Arrangement

628-22. CONNECTOR INSTALLATION

628-23. The Current Transmitter Connectors mount in any available scanner-block slot containing either a General Purpose or Low Level Scanner. Install the connectors as follows:

- Unlatch the slide fasteners located on either side of the protruding enclosure at the rear of the data logger or scanner chassis as appropriate. Remove the enclosure from the rear panel.
- Locate the desired scanner-block slot on the rear panel and check to ensure that a scanner module is installed in the slot. See Figure 628-2

for scanner block arrangement in the 2240A Data Logger.

- c. With the Current Transmitter Connector key positioned at the top, insert the connector in the scanner block guides until it mates with the scanner's connector.
- d. Install the two retaining screws and washers that hold the connector to the data logger rear panel.
- e. Repeat the procedure for additional connectors and install the rear-panel enclosure, routing the connector input cables out of the slot at the bottom of the enclosure.

628-24. OPERATION

628-25. To set up the data logger for current measurement using the Current Transmitter Connectors, proceed

as follows:

- a. Turn data logger power OFF.
- b. Select the desired connector according to the required current range as follows:
Option —28 1 to 5 mA (0 to 64.5 mA)
Option —29 4 to 20 mA (0 to 129 mA)
Option —30 10 to 50 mA (0 to 204 mA)
- c. Connect current transmitters or other inputs to the connector as desired, following the instructions in paragraph 628-14.
- d. Attach the wired Current Transmitter Connector to the desired scanner, following the instructions given in paragraph 628-16.
- e. Turn data logger power ON.

Table 628-1. Current Transmitter Connector Specifications

Type Connector: Current Transmitter

Compatibility: Mates with 2200A-05 and 2200A-06 scanners

Range	Current Transmitter	Maximum Input
Option 2240A-28:	1 to 5 mA dc	0 to 64.5 mA dc
Option 2240A-29:	4 to 20 mA dc	0 to 129 mA dc
Option 2240A-30:	10 to 50 mA dc	0 to 204 mA dc

Number of Inputs: 10

Number of Terminals: 30 (HI, LO, and Shield) with a current shunt resistor connected between each HI and LO terminal.

Terminal Style: Screw type

Shunt Resistances

Option 2240A-28:	60Ω
Option 2240A-29:	15Ω
Option 2240A-30:	6Ω

Maximum Input Power: (each input channel) 0.25W

Accuracy of Measurement: (20°C to 30°C) Add 0.1% of reading to all data logger accuracy specifications.

Temperature Coefficient:
(0°C to 20°C, 30°C to 50°C)

General Purpose A-D Converter	High Performance A-D Converter
(0.0025% of reading +0.001% of range)/°C	(0.0015% of reading +0.001% of range)/°C

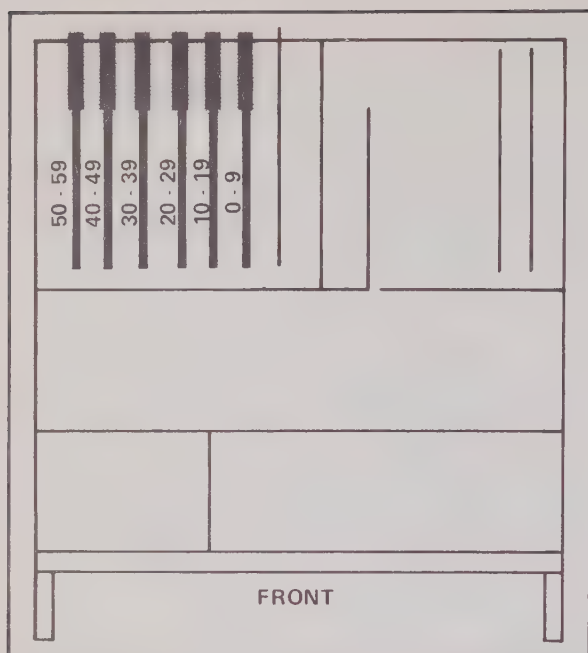


Figure 628-2.

Scanner Block Locations in the Model 2240A Data Logger

Table 628-2. Data Logger Function and Range Programming for Current Transmitter Connectors

Current Transmitter Connector	Corresponding Voltage Output to Data Logger	Data Logger Function and Range Programming for Optimum Readout
For Current Transmitter Inputs		
Option —28 1 to 5 mA	60 to 300 mV	400 mV*
Option —29 4 to 20 mA	60 to 300 mV	400 mV*
Option —30 10 to 50 mA	60 to 300 mV	400 mV*
For Maximum Range Inputs		
Option —28 0 to 64.5 mA	0 to 3.87V	4V
Option —29 0 to 129 mA	0 to 1.935V	4V
Option —30 0 to 204 mA	0 to 1.224V	4V
*Or Current Transmitter input with -11 Temperature and Scaling Option.		

- f. Program the data logger for current transmitter or maximum range inputs, as shown in Table 628-2, for maximum resolution. Note that for current transmitter inputs, 100 mV of overrange capability is provided or 1.66 mA, 6.6 mA and 16.6 mA at the input connector for 1 to 5 mA, 4 to 20 mA and 10 to 50 mA inputs, respectively.

- g. Refer to Section 2 of the data logger manual for detailed instructions concerning programming of the data logger scan, display and printout.

628-26. CALIBRATION

628-27. The shunt resistors in the Current Transmitter Connectors have been factory selected and do not require calibration. However, a calibration check is required after repairs or any time it is desired to verify shunt resistor accuracy. The following procedure requires a digital multimeter capable of measuring resistance in true 4-terminal ohms configuration. Required specifications for the digital multimeter are given in Table 628-3.

- Remove the cover from the Current Transmitter Connector.
- Connect the digital multimeter OHMS SOURCE leads to CH0 HI and LO terminals as shown in Figure 628-3.
- Connect the digital multimeter HI and LO OHMS SENSE leads to the terminals of resistor R6. Be sure the HI and LO OHMS SENSE leads are connected to the proper terminal of the resistor as shown in Figure 628-3.
- Set digital multimeter controls for resistance measurement on the 200Ω range.
- Verify digital multimeter readout as shown in Table 628-4.

Table 628-3. Required Test Equipment

Instrument Type	Minimum Use Specifications	Recommended Model
Digital Multimeter	Range: 0 to 60Ω Resolution: 1 mΩ Accuracy: ±0.01% Configuration: 4-Terminal Ohms	Fluke Model 8800A

Table 628-4. Shunt Resistor Calibration Check

Current Transmitter Connector	Required DVM Readout Using 4-Terminal Ohms Measurement Connections
Option —28 1 to 5 mA	60.000Ω ±0.024Ω
Option —29 4 to 20 mA	15.000Ω ±0.006Ω
Option —30 10 to 50 mA	6.000Ω ±0.003Ω

- f. Repeat steps (b) through (e) for channels CH1 through CH9 with OHMS SENSE leads connected to the corresponding shunt resistor for each channel, R7 through R15, respectively.
- g. If the requirements of this test are not met, the associated shunt resistor, R6 through R15, should be replaced.
- h. This concludes the calibration check of the Current Transmitter Connector.

628-28. LIST OF REPLACEABLE PARTS

628-29. Tables 628-5 through 628-7 contain a list of replaceable parts for the Current Transmitter Connectors. For an explanation of column headings and ordering information, refer to Section 5 of the data logger manual.

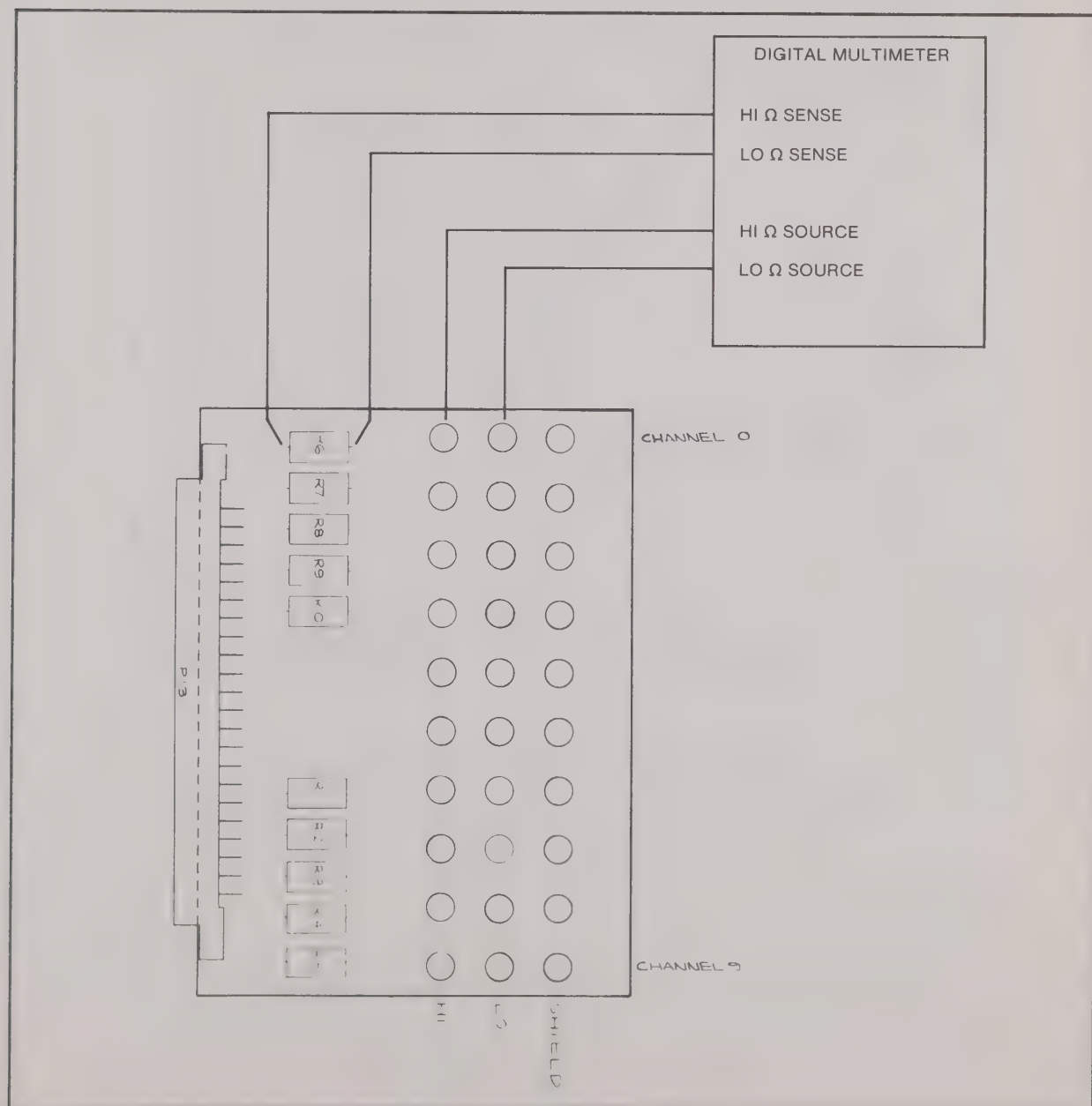


Figure 628-3. Equipment Connections for Shunt Resistor Accuracy Check

Table 628-5. Current Transmitter Connector, 2240A-28

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	CURRENT TRANSMITTER CONNECTOR FINAL ASSEMBLY, 2240A-28	431817		431817	1		
	1-5 mA Current Transmitter Input Assembly (2200A-1033)	439448	89536	439448	1		
	Decal, current transmitter	428920	89536	428920	1		
	Housing, connector	414276	89536	414276	2		
	Screw, 6-32 x 1/4	152140	89536	152140	8		
	Screw, SS, 4-40 x 7/8	335133	89536	335133	2		
	Tape, foam, 0.86 ft.	424127	31753	R338	1		
	Washer, SS, flat	146225	86928	5710-18-32	2		
	1-5 mA CURRENT TRANSMITTER INPUT ASSEMBLY (2200A-1033) Figure 628-4	439448		439448	REF		
P13	Connector, PCB	385674	89536	385674	1		
R6-R15	Res, ww	438499	89536	438499	10		
1	Screw, SS, 6-32 x 1/4	385410	89536	385401	30		

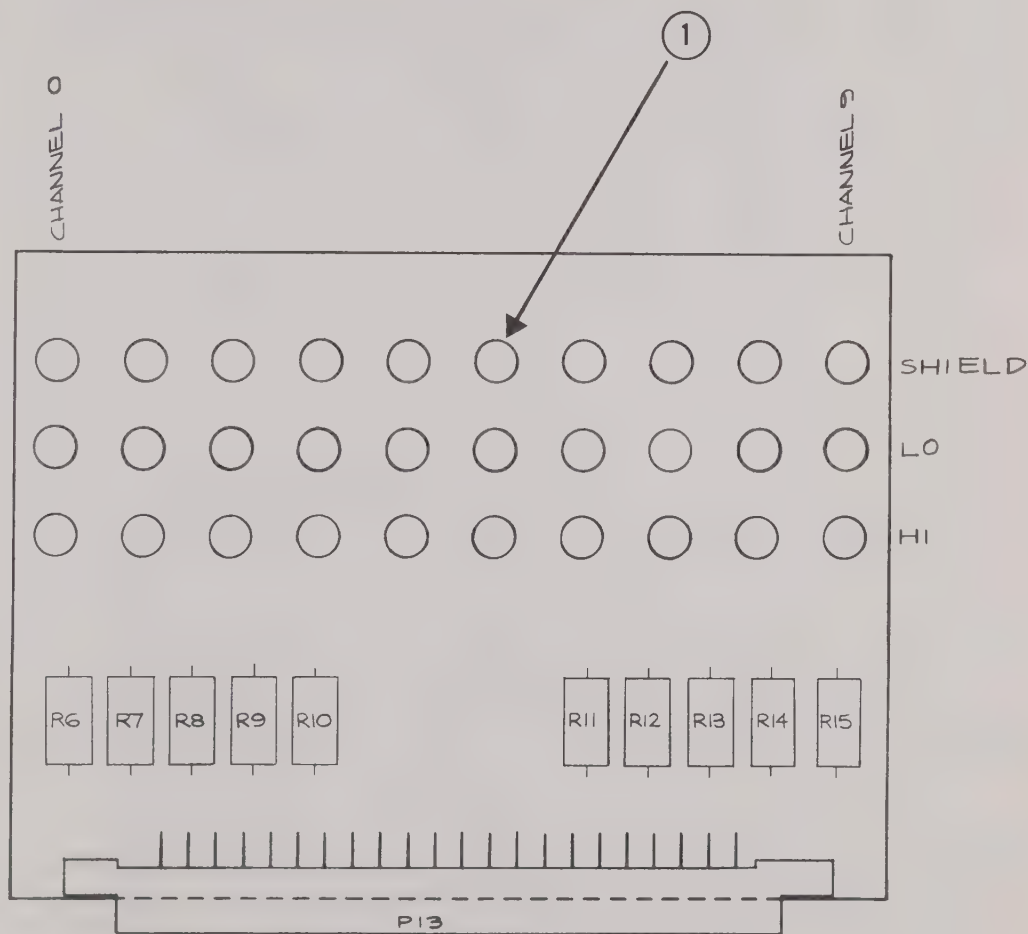
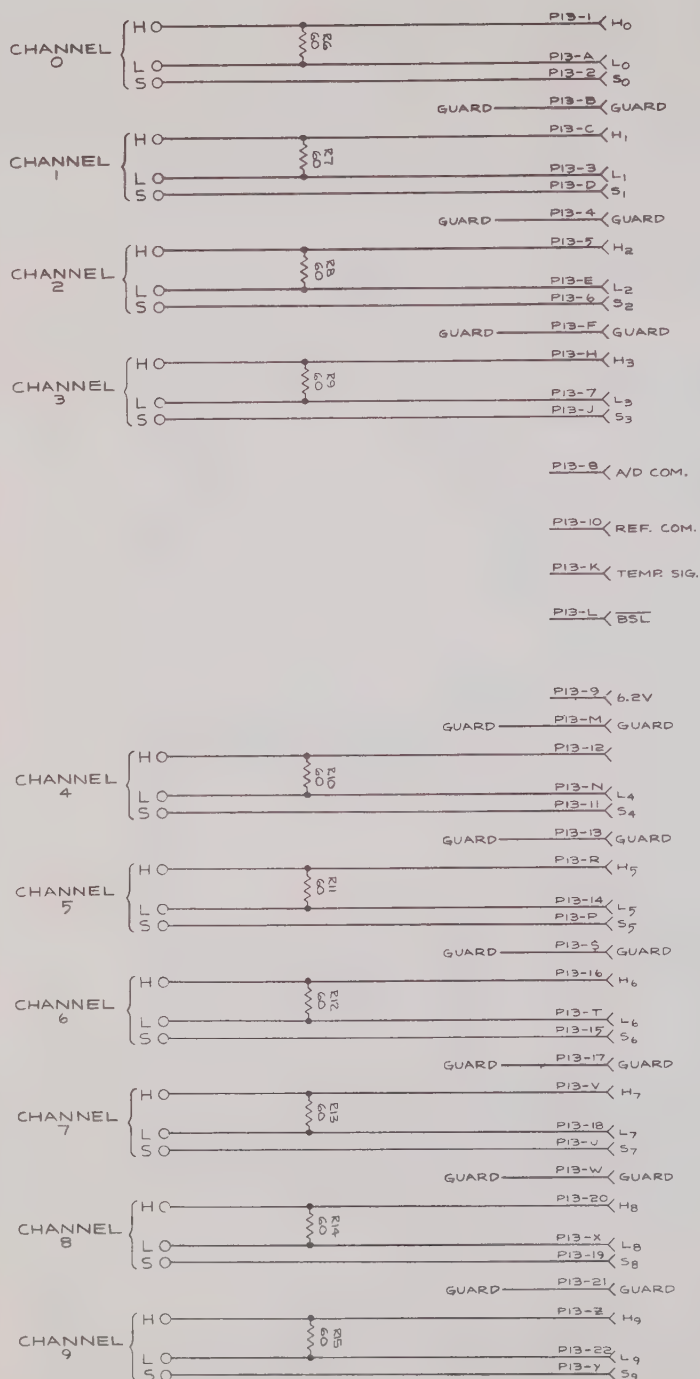


Figure 628-4. 1-5 mA, Current Transmitter Input Assembly (2200A-1033) (Sheet 1 of 2)



NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
2. ○ DENOTES CALIBRATION ADJ. POINTS. ALL POINTS ARE SCREWDRIVER ADJUST.
3. ALL RESISTORS ARE 1/8W, .04% UNLESS OTHERWISE NOTED.
4. ALL GRAPHIC SYMBOLS IN ACCORDANCE WITH ANSI Y32.2.
5. FOR ASSY DWG. SEE 2200A-4033.

A	1
B	2
C	3
D	4
E	5
F	6
G	7
H	8
J	9
K	10
L	11
M	12
N	13
P	14
R	15
S	16
T	17
U	18
V	19
W	20
X	21
Z	22

REAR VIEW OF P13

Figure 628-4. 1-5 mA, Current Transmitter Input Assembly (2200A-1033) (Sheet 2 of 2)

Table 628-6. Current Transmitter Connector, 2240A-29

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	CURRENT TRANSMITTER CONNECTOR FINAL ASSEMBLY, 2240A-29	431825		431825	1		
	4-20 mA Current Transmitter Input Assembly (2200A-1034)	439455	89536	439455	1		
	Decal, current transmitter	428920	89536	428920	1		
	Housing, connector	414276	89536	414276	2		
	Screw, 6-32 x 1/4	152140	89536	152140	8		
	Screw, SS, 4-40 x 7/8	335133	89536	335133	2		
	Tape, foam, 0.86 ft.	424127	31753	R338	1		
	Washer, SS, flat	146225	86928	5710-18-32	2		
	4-20 mA CURRENT TRANSMITTER INPUT ASSEMBLY (2200A-1034) Figure 628-5	439455		439455	REF		
P13	Connector, PCB	385674	89536	385674	1		
R6-R15	Res, ww, $15\Omega \pm 0.04\%$, 1/8W	438481	89536	438481	10		
1	Screw, SS, 6-32 x 1/4	385401	89536	385401	30		

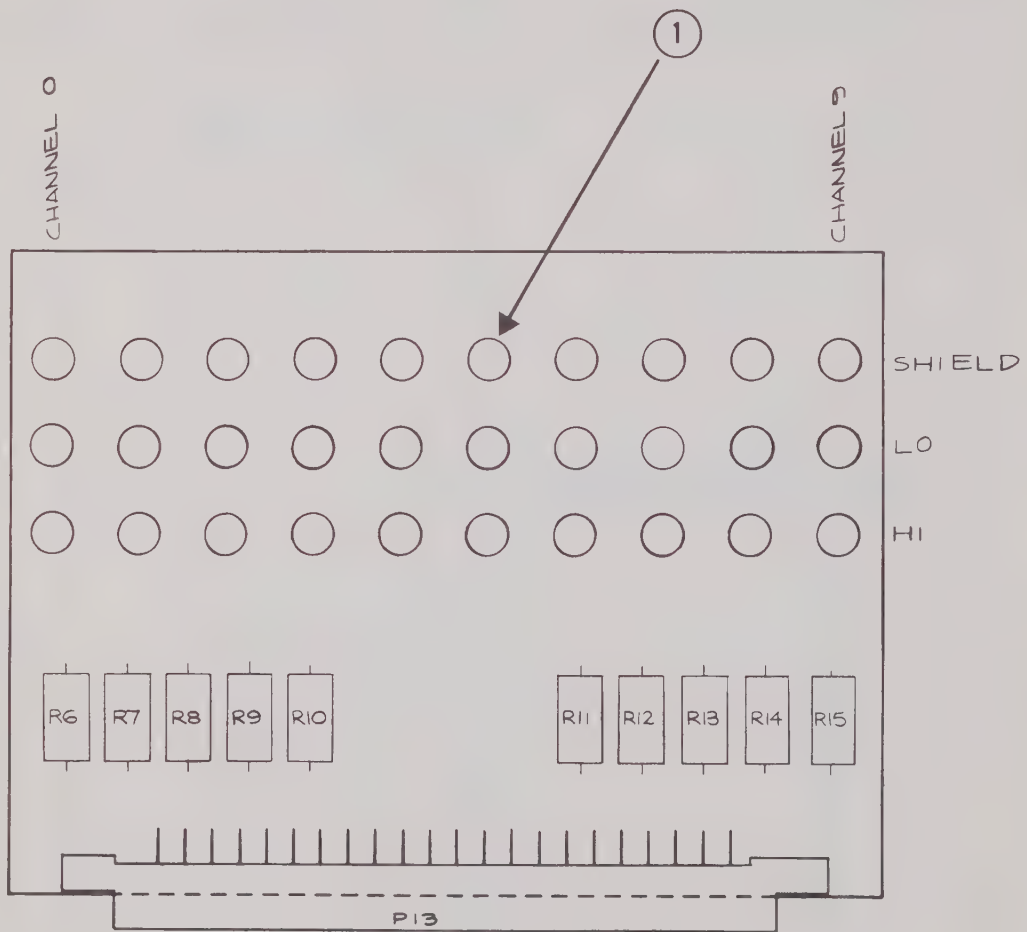
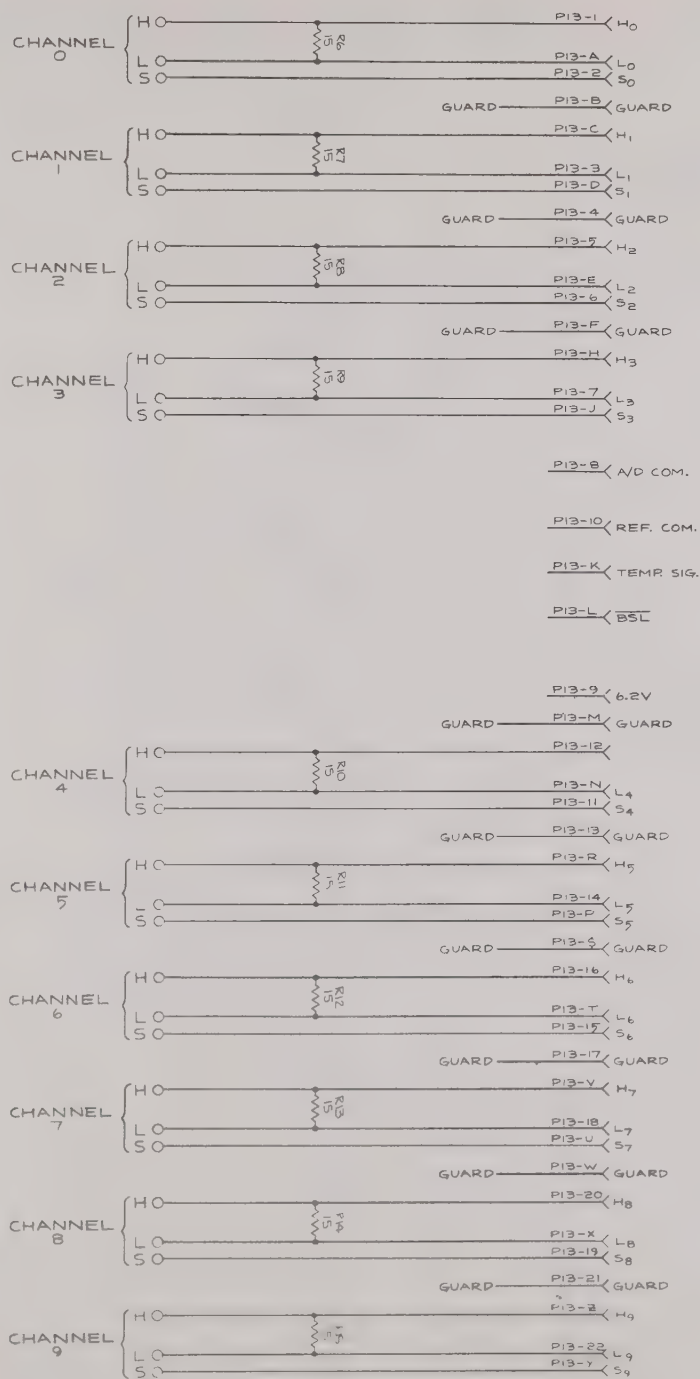


Figure 628-5. 4-20 mA Current Transmitter Input Assembly (2200A-1034) (Sheet 1 of 2)



NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
2. ○ DENOTES CALIBRATION ADJ. POINTS. ALL POINTS ARE SCREWDRIVER ADJUST.
3. ALL RESISTORS ARE 1/8W, .04% UNLESS OTHERWISE NOTED.
4. ALL GRAPHIC SYMBOLS IN ACCORDANCE WITH ANSI Y32.2.
5. FOR ASSY. DWG. SEE 2200A-4034

A	1
B	2
C	3
D	4
E	5
F	6
G	7
H	8
I	9
J	10
K	11
L	12
M	13
N	14
O	15
P	16
Q	17
R	18
S	19
T	20
U	21
V	22
W	23
X	24
Y	25
Z	26

REAR VIEW OF P13

Figure 628-5. 4-20 mA Current Transmitter Input Assembly (2200A-1034) (Sheet 2 of 2)

Table 628-7. Current Transmitter Connector, 2240A-30

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	CURRENT TRANSMITTER CONNECTOR FINAL ASSEMBLY, 2240A-30	431833	89536	431833	1		
	10-50 mA Current Transmitter Input Assembly (2200A-1035)	439463	89536	439463	1		
	Decal, current transmitter	428920	89536	428920	1		
	Housing, connector	414276	89536	414276	2		
	Screw, 6-32 x 1/4	152140	89536	152140	8		
	Screw, SS, 4-40 x 7/8	335133	89536	335133	2		
	Tape, foam, 0.86 ft.	424127	31753	R338	1		
	Washer, SS, flat	146225	86928	5710-18-32	2		
	10-50 mA CURRENT TRANSMITTER INPUT ASSEMBLY (2200A-1633) Figure 628-6	439463	89536	439463	REF		
P13	Connector, PCB	385674	89536	385674	1		
R6-R15.	Res, ww, $6\Omega \pm 0.04\%$, 1/8W	438473	89536	438473	10		
1	Screw, SS, 6-32 x 1/4	385401	89536	385401	30		

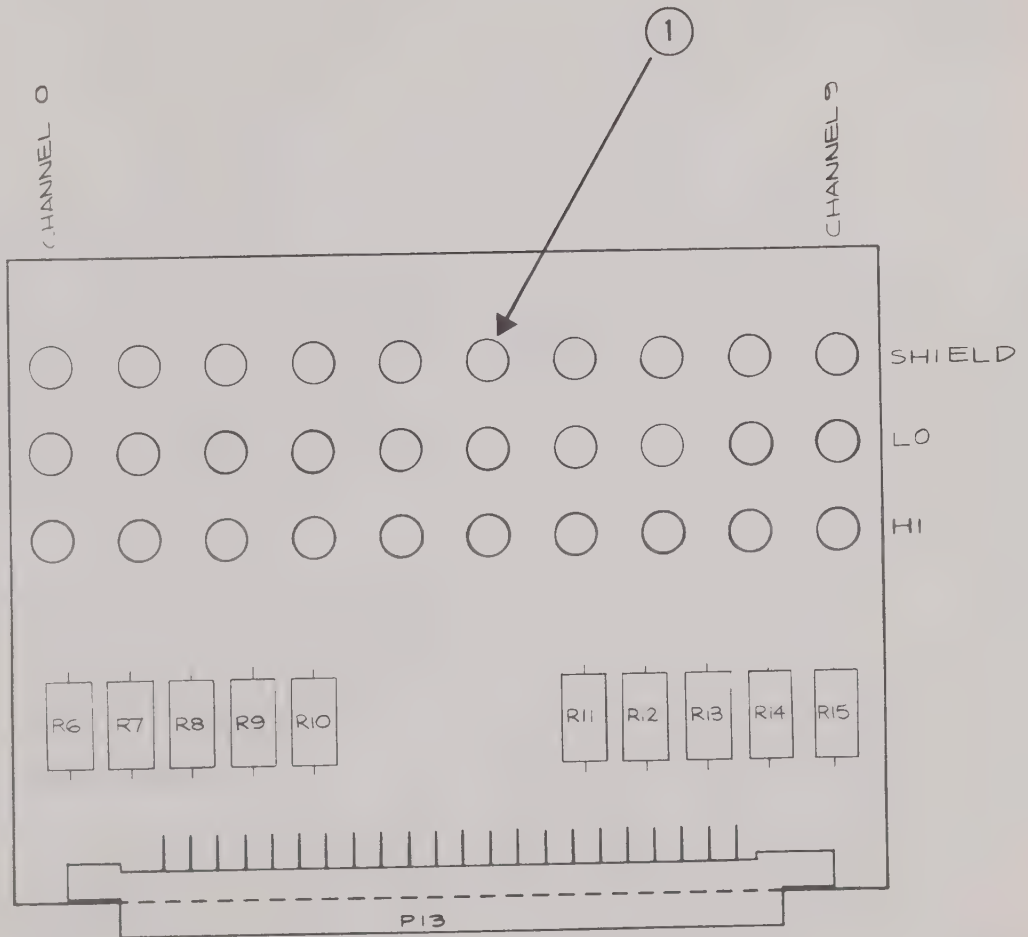


Figure 628-6. 10-50 mA Current Transmitter Input Assembly (2200A-1035) (Sheet 1 of 2)

Option -32 Dual Interval

632-1. INTRODUCTION

632-2. The Dual Interval, Option -32, is a factory installed software addition that provides the data logger with a second programmable scan control interval mode. This second interval can be controlled locally via the front panel keyboard or remotely if a Remote Programming Interface (Option -17) is installed. It has a range of 1 minute minimum to 99 hours and 59 minutes maximum. First and last channel assignments are independent of the standard scan format assignments.

632-3. As with the standard interval, the second interval can be enabled or disabled by programming its time. Setting a time of zero disables the interval, and setting a time other than zero enables the interval. When both intervals are enabled the standard interval has priority.

632-4. SPECIFICATIONS

632-5. Specifications for the Dual Interval option are as follows:

INTERVAL TIME

Minimum: 1 minute

Maximum: 99 hours, 59 minutes

CHANNEL LIMITS: None (000 to 999)

PROGRAM ENTRY: Manual (front panel)
or remote (Option -17)

632-6. OPERATING NOTES

632-7. When the Dual Interval option is installed, operation of the data logger is altered from that described in Section 2. These variations are discussed in the following paragraphs.

632-8. Program List

632-9. When a program list is manually solicited the second interval time is printed after the standard program list is complete. This is followed by a list of first to last channels as assigned to the second interval. The channel format is the same as that of the standard scan.

632-10. When a program list is remotely solicited (via Remote Programming Interface) the second interval time, its first channel, and its last channel are listed after the standard program list format. This is followed by a list of first to last channels assigned to the second interval.

632-11. Program list can be printed on an external recorder or on the interval printer. Program Code P solicits a program list on an external printer. Code Q solicits a program list on the internal printer. See Remote Programming information (later in this subsection) or Option —17 documentation for additional details. Remember, set SCAN CONTROL to RESET and OUTPUT CONTROL to ALL DATA before attempting to solicit a program list.

632-12. Scan Control Modes

632-13. The effect of the second interval function on each of the scan modes is summarized in Table 632-1. Standard interval operation is not affected.

632-14. In the single and continuous scan modes the standard first and last channel assignments determine the channels to be scanned. In the continuous scan mode with the INTERVAL DATA print switch depressed the second interval channels are not scanned unless a second interval time has been entered. If both interval programs simultaneously initiate print records, the standard interval data is recorded first and is followed by second interval data. If the standard interval time is less than

the time necessary to record the standard interval data, the second interval will not be recorded.

632-15. In the monitor scan mode with the INTERVAL DATA print switch depressed both time intervals will cause a record of the monitor channel. The standard interval has priority when both intervals simultaneously trigger a record.

632-16. In the interval scan mode with either the INTERVAL DATA or the ALL DATA switch depressed, both time intervals will be recorded upon initiation of the scan. This occurs even if one of the interval times is set to zero. The interval that is set to zero will not trigger subsequent scans.

Table 632-1. Scan Control vs Second Interval

SCAN CONTROL MODE	SECOND INTERVAL CHANNELS SCANNED AND DISPLAYED	OUTPUT RECORD TRIGGERED BY SECOND INTERVAL
Single	No	No
Interval	Yes	Yes
Monitor	No	Yes
Continuous	No	Yes

632-17. OPERATION

632-18. The Dual Interval can be programmed manually from the front panel keyboard or remotely through a Remote Programming Interface (Option -17). Instructions for both methods are given in the following paragraphs.

632-19. Keyboard Entry

632-20. Use the following procedure to enter second interval program data from the front panel keyboard:

1. Press the SECOND INTERVAL switch in the DATA ENTRY switch group. The display will show a series of t's (tttttt).
2. Press the INTERVAL switch in the SCAN FORMAT switch group. The interval time in memory will be displayed, e.g., tt 99.59 (99 hours, 59 minutes, seconds remain blank).

3. Enter the desired interval time on the DATA ENTRY keyboard and then press ENTER/STEP.
4. Press the SECOND INTERVAL switch followed by the FIRST CHANNEL switch. The display will read the first channel data in memory, e.g., 001 tttt.
5. Enter the desired first channel on the DATA ENTRY keyboard. When properly displayed press ENTER/STEP.
6. Enter last channel data by pressing SECOND INTERVAL, LAST CHANNEL, last channel value on keyboard, and then ENTER/STEP.

632-21. Remote Programming

632-22. The Dual Interval function can be remotely programmed when the data logger is equipped with a Remote Programming Interface (Option -17) that has version 1 (or higher) software installed. Programming information for the Dual Interval option is given in Table 632-2. If an error code of ERR07 is returned, the Dual Interval option is not installed. Error code ERR03 indicates that Option -17 is equipped with version 0 software (i.e., not compatible with the Dual Interval option). Refer to the Option -17 documentation for additional programming details.

NOTE

Software version used on Option -17 can be easily identified by the markings on its IC's in locations U1, U2, U3, U6, U7, and/or U8. Version 0 software is marked RPC —. Version 1 and on is marked RPC V —.

Table 632-2. Remote Programming

CODE	FORMAT	FUNCTION
G	Gaaa	Sets First Channel of Dual Interval to aaa (000 to 999).
K	Kaaa	Sets Last Channel of Dual Interval to aaa (000 to 999).
J	Jbb, cc	Sets Dual Interval time to bb hours (00 to 99) and cc minutes (00 to 59).
Q	Q	Program List on internal printer.

-33 Option Eight Channel RTD Scanner

633-1. INTRODUCTION

633-2. The RTD Scanner (Option -33) is an eight-channel, two-wire relay scanner which operates in conjunction with the 2200 series data logger and an RTD Input Connector (2200A-03) to provide excitation current and multiplex switching for up to eight RTD (resistance-temperature-device) inputs. The scanner can be installed in any one of the available scanner pcb slots in the data logger or an associated scanner chassis. Scanner input connections for the RTD's are accomplished using the 2200A-03 RTD Input Connector. When a channel is selected, reed relays in the scanner connect the RTD input to the data logger's analog bus. At the same time an on-board reference supply is energized to supply an adjustable excitation current (1 mA nominal) to the selected RTD. The resultant I-R drop is measured as a voltage and displayed in terms of temperature by the data logger.

633-3. SPECIFICATIONS

633-4. Specifications for the RTD Scanner are given in Table 633-1.

633-5. INSTALLATION

633-6. The Eight Channel RTD Scanner can be installed in any one of the scanner locations in a 2200B/2240B Data Logger. Use the following procedure to install a scanner.

WARNING

REMOVE LINE-POWER AND ALL OTHER HIGH VOLTAGE INPUTS TO THE DATA LOGGER BEFORE STARTING THIS PROCEDURE.

- a. Remove the top cover and the inner top-guard cover from the data logger.

CAUTION

Handle the scanner pcb by its edges to avoid contaminating the pcb with oil from the hands. The use of gloves is recommended.

- b. Select the location that includes the block of channels the scanner is to represent and align the scanner in the slot so that the large board-edge connector is toward the rear of the unit and the small offset board-edge connector is toward the bottom of the unit. Push the scanner straight down onto the mating connectors.

- c. Prior to use, test and calibrate the scanner using the procedures given later under maintenance.

- d. Install the inner guard cover and the top cover.

633-7. OPERATION

633-8. Once installed in the data logger the Eight-Channel RTD Scanner requires no operator attention. However, certain considerations are necessary to properly interface the scanner with the RTD's. These considerations are discussed in the following paragraphs.

633-9. Input Connections

633-10. The 2200/2240 series data loggers accept three types of input connectors depending on the type of scanner in use. The General Purpose and Low Level Scanners are compatible with both the -07 Solder Pin Connector and -08 Isothermal Connector. Refer to Option -07 and -08 subsections in Section 6 of the data logger manual for instructions covering hookup and installation of these connectors. The RTD Scanner is only compatible with the RTD Connector. Refer to Option -03 subsection in Section 6 of this manual for RTD Connector hookup and installation instructions. Refer to the following paragraphs for applications information concerning three- and four-terminal RTD measurements.

Table 633-1. RTD Scanner Specifications

RTD Channels:	8
Ice-Point Resistance (standard):	100Ω ±0.8%
Temperature Range:	−200°C to +775°C, −328°F to +1427°F
Linearization Conformity:	0.035°C or 0.063°F
Resolution:	0.1°C or 0.1°F
System Accuracy:	NOTE: Specifications do not include sensor error.

	TEMP RANGE	90-DAY 25 ±5°C SLOW	1-YEAR 25 ±10°C	
			FAST	SLOW
High Performance A/D (−10)	−200°C to −450°C	0.3°C	0.4°C	0.4°C
	−450°C to +800°C	0.3°C	0.4°C	0.6°C
	−328°F to +700°F	0.6°F	0.7°F	0.8°F
	+700°F to +1472°F	0.6°F	0.8°F	1.0°F
General Purpose A/D (−09)	−200°C to +400°C	0.4°C	N/A	0.5°C
	+400°C to +800°C	0.6°C	N/A	0.7°C
	−328°F to +800°F	0.7°F	N/A	0.8°F
	+800°F to +1472°F	1.0°F	N/A	1.2°F

Slow: 2.5 Rdgs/Sec

Fast: 15 Rdgs/Sec

633-11. Input Pin Assignments

633-12. The pin assignments for the rear panel, card-edge connector of the RTD Scanner are shown in Figure 633-1. Since contact with signals on this connector are completed through the −03 RTD Connector, to the −03 Option subsection in this manual for pin assignments available for fabricating RTD interface cables.

633-13. Four-Terminal Measurements

633-14. Four-terminal RTD's must be connected to the scanner in true four-terminal configuration to achieve full accuracy from the system. Four-terminal RTD's are supplied by the manufacturer with four leads, usually two of one color and two of another. (Color code and other identifying marks on RTD's vary with the manufacturer.) The two leads with a common connection at one end of the RTD should be connected to the HI and +S terminals of the RTD Connector and the remaining two leads should be connected to the LO and −S (sense terminals) of the RTD Connector. Figure 633-2 shows an example of four-terminal RTD connections to channel 0 (CH0) and channel 1 (CH1) of the RTD Connector with the RTD's having four wires, two red and two white.

TOP		
H0	A 1	H0
+S0	B 2	−S0
H1	C 3	L1
−S1	D 4	+S1
L2	E 5	H2
+S2	F 6	−S2
H3	H 7	L3
−S3	J 8	+S3
—	K 9	—
—	L 10	+S4
SHIELD	M 11	—
L4	N 12	H4
−S5	P 13	+S5
H5	R 14	L5
+S6	S 15	−S6
L6	T 16	H6
−S7	U 17	+S7
H7	V 18	L7
NC	W 19	NC
↑	X 20	↑
↓	Y 21	↓
NC	Z 22	NC

Figure 633-1. RTD Scanner Rear Panel Connector
Pin Assignments

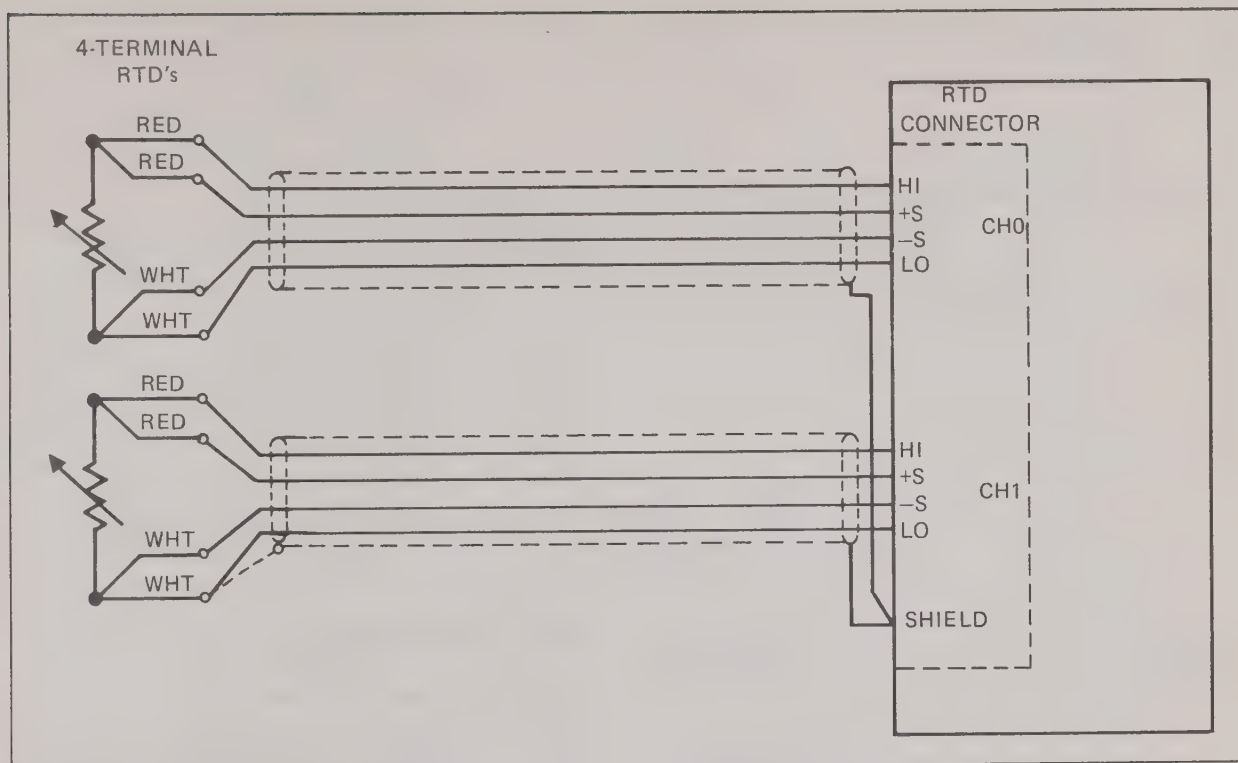


Figure 633-2. Example of Four-Terminal RTD Connections

Additional four-terminal RTD's would be connected in exactly the same manner to HI, LO, +S and -S terminals of any other available channels in the RTD Connector, up to a maximum of eight per scanner. When shielded input cables are used, best results are usually obtained by connecting all of the shields on the block to the common shield terminal. The best common mode rejection performance is usually obtained by connecting only one of these shields to the LO terminal at the RTD. When no shields are used, connect the shield input to the LO input of one of the channels.

633-15. It is important to note that four individual wires must be brought out from the scanner to connect to each four-terminal RTD, as shown in the diagram, to achieve true four-terminal RTD measurements. Connecting HI to +S and LO to -S at the scanner and extending two wires only for connection to the RTD will not provide a four-terminal measurement because sensing is not taking place at the RTD. Such a two-wire hookup actually comprises a two-terminal measurement configuration, introducing associated lead resistance error into the measurement.

633-16. Three-Terminal Measurement

633-17. Three-terminal RTD's should be connected to the scanner as shown in Figure 633-3. In this hookup, the scanner LO and -S terminals are brought out to the RTD

and connected to the common third wire of the RTD. The HI and +S terminals are connected individually to the remaining two RTD wires in the same manner as in the four-terminal hookup.

NOTE

Lead wire resistance errors are introduced by the resistance of the common or third wire of the RTD. For this reason the independent connection of -S and LO terminal should be made as close to the RTD sensing element as possible.

633-18. THEORY OF OPERATION

633-19. The RTD Scanner contains 11 form-A, double pole reed relays. A contact pair from eight of the relays, K0 through K7, is connected to two separate busses (one pole to each bus) to form a two-pole, eight-channel scanner complete with treeing relay, K10. The treeing relay operates when any one of the channel relays is operated. It is used to connect the scanner busses to the input of the data logger's A/D converter. Relay K11 operates in parallel with K10 to connect the scanner's shield to the data logger's guard. The remaining relay, K9, switches the output of the +10V reference supply onto the analog bus for measurement purposes. It is energized whenever channel 8 or 9 is selected on the

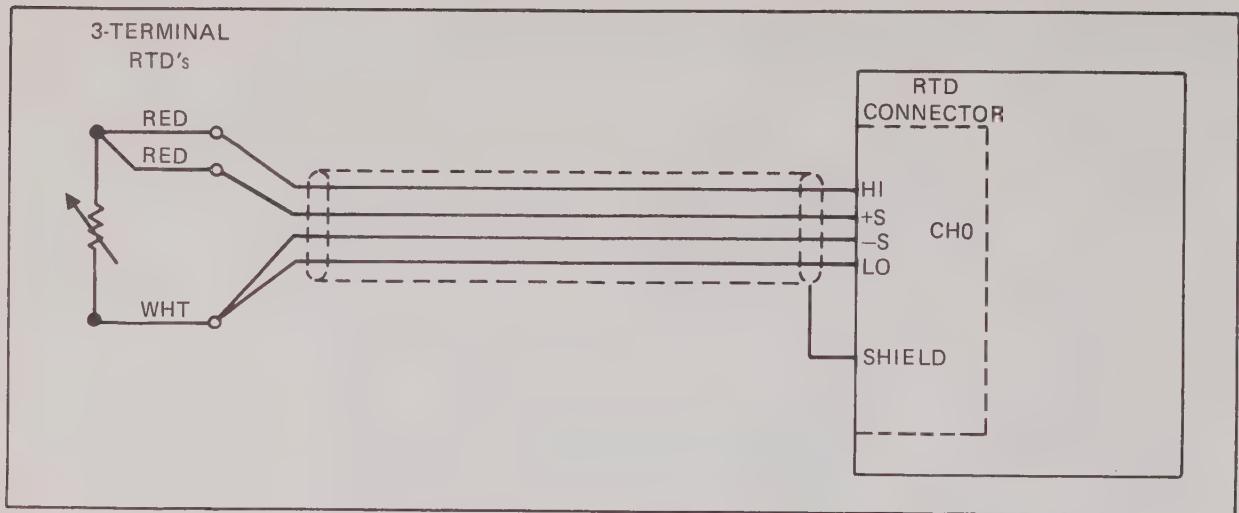


Figure 633-3. Example of Three-Terminal RTD Connections

scanner. A bcd-to-decimal decoder, U1, operates in conjunction with Q7 through Q15 to select the desired channel.

633-20. Excitation current (≈ 1 mA) for the RTD's is supplied by an on-board 10 volt precision power supply. The supply is powered by the guarded logic +5 volts supply (GL+5V) in the data logger. An inverter and a regulator on the scanner are used to generate the +10V dc output.

633-21. The power supply consists of a high frequency inverter (T1, Q1, Q2, CR1, CR2), a +15V dc regulator (U2A, Q3, Q4, CR5) and a +10V dc regulator (U2B). The inverter is energized whenever a channel on the scanner is called. This provides the two regulators with isolated ac operating voltage by way of the transformer, T1, secondary winding. The voltage is rectified and filtered before being presented to the regulator as unregulated dc power. A conventional series-pass regulator is used to establish a stable supply for operating dual op amp U2. One half of U2 is used control the +15V dc regulator. The other half is used as a feed-back amplifier to provide the +10V dc output. Both the +10 and +15V supplies use CR5 as a voltage reference.

633-22. The output of the +10V supply is applied through a precision wirewound resistor and potentiometer in each RTD input channel to the +S terminal (+source). Three other input terminals, -S (-source), HI, and LO operate with the +S terminal to provide true four-terminal ohms measurement capability. The potentiometer on each channel allows the RTD current to be adjusted for calibration purposes.

633-23. MAINTENANCE

633-24. Access Information

633-25. Refer to the installation information given in this option subsection for access information. Remove the rear panel input connector before attempting to remove the scanner pcb from the data logger.

633-26. Performance Test

633-27. The performance test is designed to verify the overall operation of the Eight-Channel RTD Scanner and is intended for use as an acceptance test and/or periodic maintenance check. The equipment used in the test is specified in Table 633-2. If the scanner fails any part of the test, corrective action is required.

- a. Turn data logger power off and disconnect the power cord from the ac line.
- b. Install the Eight-Channel RTD Scanner being tested in Block 0 of the data logger.
- c. Connect a $100\Omega \pm 0.1\%$ resistor between the +S and -S terminals of each channel (0-7) on the RTD Input Connector (Option -03).
- d. Using bare hookup wire, connect HI to +S and LO to -S on each channel of the test connector.
- e. Install the RTD test connector on the RTD Scanner in Block 0 of the data logger.
- f. Connect the data logger to line power and set the power switch to POWER ON.

g. Program the data logger to read the voltage present at channel 9. It should read $10.000 \pm 0.01V$ dc. This is the +10 volt reference supply. If the reading is not correct, complete the power supply calibration adjustment procedure (given later in this subsection) before proceeding.

h. Program the data logger to monitor the voltage at channel 0. The voltage should read approximately +100 mV dc.

i. Refer to Figure 633-4 and verify that the channel 0 potentiometer (R25) can be adjusted over a minimum range of 99.1 to 100.9 mV. Leave the adjustment set for a data logger indication of 100.00 mV.

j. Repeat steps h and i of this procedure for channels 1 through 7.

k. Program the data logger to scan and record the voltage at channels 0 through 7. Each reading should indicate 100.00 ± 0.02 mV.

l. Turn data logger power off and disconnect the power cord from the ac line.

m. Disconnect the test connector and remove the scanner. This completes the performance test.

Table 633-2. Required Test Equipment

INSTRUMENT	RECOMMENDED MODEL
Data Logger	Fluke 2200B/2240B
Input Connector	Fluke Model 2200A-03
Resistors (8 each) (1)	$100\Omega \pm 0.1\%$, ¼ watt
Thermos Bottle (2)	1 pint for 0°C ice-point bath
RTD's (2)	RTD's that will be used with the -33 Scanner
(1) Used only in Performance Test	
(2) Used only in Calibration Adjustments Procedure	

633-28. Calibration Adjustments

633-29. The Eight-Channel RTD Scanner should be calibrated when it is initially installed in a data logger, and whenever the data logger is calibrated. Calibration adjustments for the scanner are shown in Figure 633-4.

The procedure assumes that the data logger and the a/d converter calibration procedures have been completed and that the scanner is installed in its assigned location.

633-30. +10 VOLT REFERENCE

633-31. Use the following procedure to adjust the +10 volt reference supply:

a. Program the data logger to monitor the voltage on channel 9 of the scanner pcb being checked; use the 40V range. The voltage reading should be $10.000 \pm 0.010V$ dc.

b. If the reading is not within limits, adjust R9 on the scanner pcb for a reading of $10.000 \pm 0.002V$ dc.

633-32. RTD CURRENT ADJUSTMENTS

633-33. Each RTD channel that is equipped with an RTD input must be calibrated when the RTD is connected. Calibration is accomplished by making screwdriver adjustments on the scanner pcb. These adjustments set the RTD excitation current so that a known I-R (voltage) is produced across the RTD at a known temperature (0° C).

a. Determine the location of the scanner to be calibrated and attach its RTD's using the RTD Input Connector.

NOTE

RTD's are assumed to have a resistance $100\Omega \pm 0.8\%$ at 0° C.

b. Remove the top cover and the inner guard cover from the data logger.

c. Prepare a 0°C (32°F) ice-point bath using a 1 pint thermos bottle.

d. Place each RTD to be calibrated in the ice-point bath and allow the RTD temperature to stabilize.

e. Monitor each scanner channel and adjust the appropriate potentiometer (see Figure 633-4) for a reading of 00.0°C (32.0°F) on the RTD measurement function or 100.00 on the 400 mV range.

f. Install the top and inner guard covers after the calibration adjustments have been completed.

633-34. LIST OF REPLACEABLE PARTS

633-35. A list of replaceable parts for the Eight-Channel RTD Scanner is given in Table 633-3. Refer to Section 5 of this manual for ordering information.

Table 633-3. Eight Channel RTD Scanner

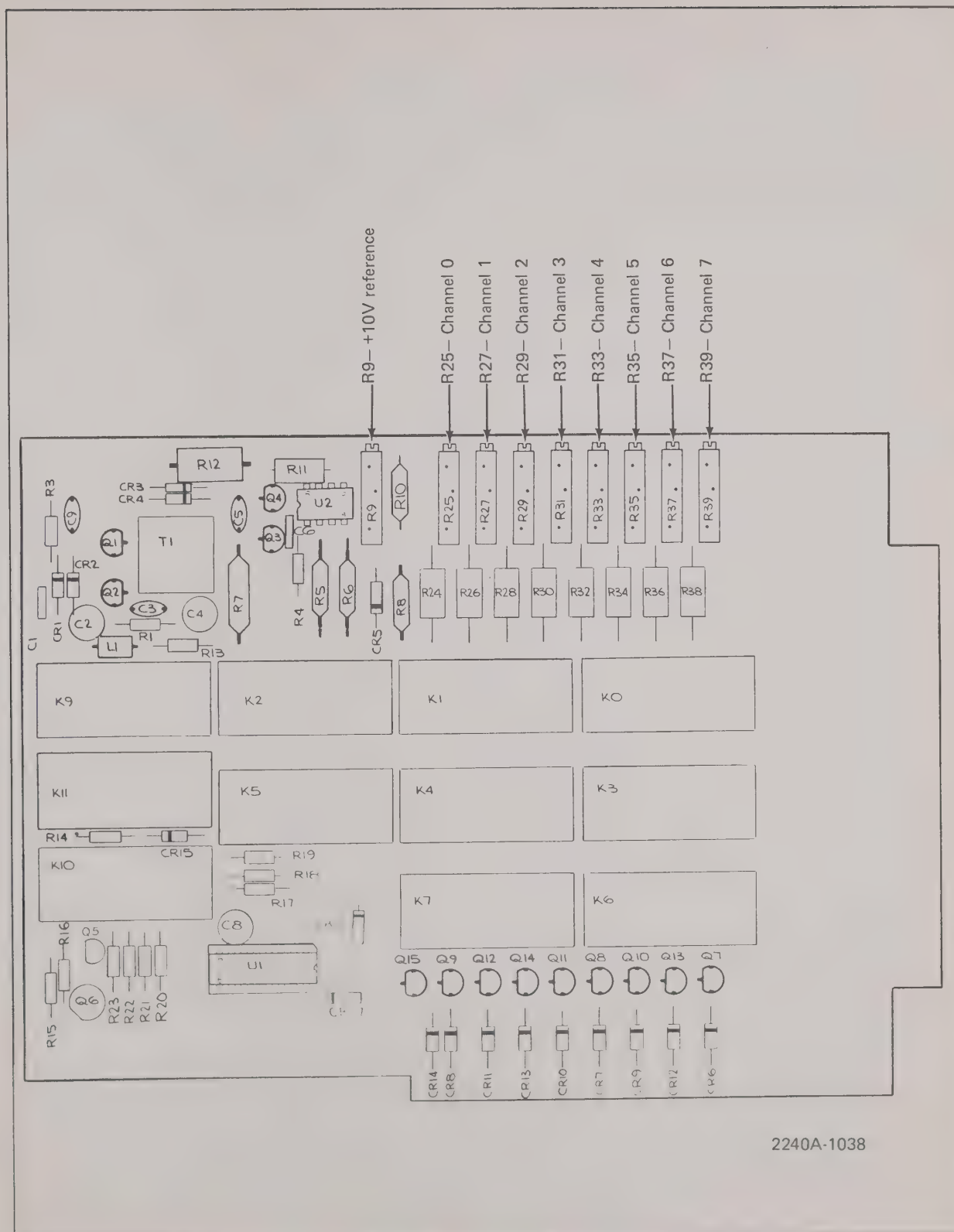
ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
EIGHT CHANNEL RTD SCANNER, OPTION -33 (2240A-4038) FIGURE 633-4							
C1	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	2		
C2	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	2		
C3	CAP, CER, 0.05 -20/+80%, 25V	148924	72982	5855-000-Y5U0-503Z	3		
C4	CAP, TA, 10 UF +/-20%, 35V	417683	56289	196D106X0035PE4	1		
C5	CAP, CER, 0.05 -20/+80%, 25V	148924	72982	5855-000-Y5U0-503Z	REF		
C6	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	REF		
C8	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	REF		
C9	CAP, CER, 0.05 -20/+80%, 25V	148924	72982	5855-000-Y5U0-503Z	REF		
CR1	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	16	6	
CR2	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR3	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR4	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR5	ZENER REFERENCE SET (INCLUDES RESISTORS R7 AND R8)	377283	89536	377283	1		
CR6	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR7	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR8	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR9	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR10	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR11	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR12	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR13	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR14	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR15	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR16	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR17	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
H1	TRANS-PAD	152207	07047	10123-DAP	1		
K0	RELAY, REED, 2-POLE, FORM-A	442921	21317	052A5*300BAA	11		
K1	RELAY, REED, 2-POLE, FORM-A	442921	21317	052A5*300BAA	REF		
K2	RELAY, REED, 2-POLE, FORM-A	442921	21317	052A5*300BAA	REF		
K3	RELAY, REED, 2-POLE, FORM-A	442921	21317	052A5*300BAA	REF		
K4	RELAY, REED, 2-POLE, FORM-A	442921	21317	052A5*300BAA	REF		
K5	RELAY, REED, 2-POLE, FORM-A	442921	21317	052A5*300BAA	REF		
K6	RELAY, REED, 2-POLE, FORM-A	442921	21317	052A5*300BAA	REF		
K7	RELAY, REED, 2-POLE, FORM-A	442921	21317	052A5*300BAA	REF		
K9	RELAY, REED, 2-POLE, FORM-A	442921	21317	052A5*300BAA	REF		
K10	RELAY, REED, 2-POLE, FORM-A	442921	21317	052A5*300BAA	REF		
K11	RELAY, REED, 2-POLE, FORM-A	442921	21317	052A5*300BAA	REF		
L1	INDUCTOR, 6-TURN	320911	89536	320911	1		
Q1	XSTR, SI, NPN	272237	89536	272237	3	1	
Q2	XSTR, SI, NPN	272237	89536	272237	REF		
Q3	XSTR, SI, NPN	272237	89536	272237	REF		
Q4	XSTR, J-FET, N-CHANNEL	261388	89536	261388	1	1	
Q5	XSTR, SI, NPN	218396	04713	2N3904	1	1	
Q6	XSTR, SI, NPN	182196	89536	182196	1	1	
Q7	XSTR, SI, PNP	195974	04713	2N3906	9	2	
Q8	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q9	XSTR, SI, PNP	195974	04713	2N3906	REF		

Table 633-3. Eight Channel RTD Scanner (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Q10	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q11	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q12	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q13	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q14	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q15	XSTR, SI, PNP	195974	04713	2N3906	REF		
R1	RES, DEP. CAR, 20K +/-5%, 1/4W	441477	80031	CR251-4-5P20K	2		
R2	RES, DEP. CAR, 330 +/-5%, 1/4W	368720	80031	CR251-4-5P330E	2		
R3	RES, DEP. CAR, 330 +/-5%, 1/4W	368720	80031	CR251-4-5P330E	REF		
R4	RES, DEP. CAR, 20K +/-5%, 1/4W	441477	80031	CR251-4-5P20K	REF		
R5	RES, MF, 143K +/-1%, 1/8W	291336	91637	CMF551433F	1		
R6	RES, MF, 100K +/-1%, 1/8W	248807	91637	CMF551003F	1		
R7	SEE CR5				REF		
R8	SEE CR5				REF		
R9	RES, VAR, 1K +/-10%, 1/2W	267856	89536	267856	1	1	
R10	RES, MF, 61.9K +/-1%, 1/8W	237230	91637	CMF556192F	1		
R11	RES, WW, 11.35K +/-0.1%, 0.15W	385542	89536	385542	1	1	
R12	RES, WW, 6.983K +/-0.05%, 1/4W	292896	89536	292896	1	1	
R13	RES, DEP. CAR, 100 +/-5%, 1/4W	348771	80031	CR251-4-5P100E	1		
R14	RES, DEP. CAR, 68 +/-5%, 1/4W	414532	80031	CR251-4-5P68E	1		
R15	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	4		
R16	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	1		
R17	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	REF		
R18	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	REF		
R19	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	REF		
R20	RES, DEP. CAR, 100K +/-5%, 1/4W	348920	80031	CR251-4-5P100K	4		
R21	RES, DEP. CAR, 100K +/-5%, 1/4W	348920	80031	CR251-4-5P100K	REF		
R22	RES, DEP. CAR, 100K +/-5%, 1/4W	348920	80031	CR251-4-5P100K	REF		
R23	RES, DEP. CAR, 100K +/-5%, 1/4W	348920	80031	CR251-4-5P100K	REF		
R24	RES, WW, 9.8K 0.1%, 0.15W	446484	89536	446484	8	2	
R25	RES, VAR, 200 +/-20%, 1/2W	284711	11236	190PC201B	8	2	
R26	RES, WW, 9.8K 0.1%, 0.15W	446484	89536	446484	REF		
R27	RES, VAR, 200 +/-20%, 1/2W	284711	11236	190PC201B	REF		
R28	RES, WW, 9.8K 0.1%, 0.15W	446484	89536	446484	REF		
R29	RES, VAR, 200 +/-20%, 1/2W	284711	11236	190PC201B	REF		
R30	RES, WW, 9.8K 0.1%, 0.15W	446484	89536	446484	REF		
R31	RES, VAR, 200 +/-20%, 1/2W	284711	11236	190PC201B	REF		
R32	RES, WW, 9.8K 0.1%, 0.15W	446484	89536	446484	REF		
R33	RES, VAR, 200 +/-20%, 1/2W	284711	11236	190PC201B	REF		
R34	RES, WW, 9.8K 0.1%, 0.15W	446484	89536	446484	REF		
R35	RES, VAR, 200 +/-20%, 1/2W	284711	11236	190PC201B	REF		
R36	RES, WW, 9.8K 0.1%, 0.15W	446484	89536	446484	REF		
R37	RES, VAR, 200 +/-20%, 1/2W	284711	11236	190PC201B	REF		
R38	RES, WW, 9.8K 0.1%, 0.15W	446484	89536	446484	REF		
R39	RES, VAR, 200 +/-20%, 1/2W	284711	11236	190PC201B	REF		
T1	XFMR, INVERTER	462093	89536	462093	1		
U1	IC, C-MOS, BCD-TO-DECIMAL DECODER	407981	12040	MM74C42N	1		
U2	IC, LINEAR, OP AMP (SELECTED)	418566	89536	418566	1	1	
XU1	SOCKET, IC, 16-PIN DIP	370312	91506	316-AG39D	1		



Figure 633-4. Eight Channel RTD Scanner PCB Assembly



2240A-1038

Figure 633-5. Eight Channel RTD Scanner PCB Assembly (cont)

Section 7

General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the List of Replaceable Parts contained in Section 5.

List of Abbreviations and Symbols

A or amp	ampere	hf	high frequency	(+) or pos	positive
ac	alternating current	Hz	hertz	pot	potentiometer
af	audio frequency	IC	integrated circuit	p-p	peak-to-peak
a/d	analog-to-digital	if	intermediate frequency	ppm	parts per million
assy	assembly	in	inch(es)	PROM	programmable read-only memory
AWG	american wire gauge	intl	internal	psi	pound-force per square inch
B	bel	I/O	input/output	RAM	random-access memory
bcd	binary coded decimal	k	kilo (10 ³)	rf	radio frequency
°C	Celsius	kHz	kilohertz	rms	root mean square
cap	capacitor	kΩ	kilohm(s)	ROM	read-only memory
ccw	counterclockwise	kV	kilovolt(s)	s or sec	second (time)
cer	ceramic	lf	low frequency	scope	oscilloscope
cermet	ceramic to metal(seal)	LED	light-emitting diode	SH	shield
ckt	circuit	LSB	least significant bit	Si	silicon
cm	centimeter	LSD	least significant digit	serno	serial number
cmrr	common mode rejection ratio	M	mega (10 ⁶)	sr	shift register
comp	composition	m	milli (10 ⁻³)	Ta	tantalum
cont	continue	mA	milliampere(s)	tb	terminal board
crt	cathode-ray tube	max	maximum	tc	temperature coefficient or temperature compensating
cw	clockwise	mf	metal film	tcxo	temperature compensated crystal oscillator
d/a	digital-to-analog	MHz	megahertz	tp	test point
dac	digital-to-analog converter	min	minimum	u or μ	micro (10 ⁻⁶)
dB	decibel	mm	millimeter	uhf	ultra high frequency
dc	direct current	ms	millisecond	us or μs	microsecond(s) (10 ⁻⁶)
dmm	digital multimeter	MSB	most significant bit	uut	unit under test
dvm	digital voltmeter	MSD	most significant digit	V	volt
elect	electrolytic	MTBF	mean time between failures	v	voltage
ext	external	MTTR	mean time to repair	var	variable
F	farad	mV	millivolt(s)	vco	voltage controlled oscillator
°F	Fahrenheit	mv	multivibrator	vhf	very high frequency
FET	Field-effect transistor	MΩ	megohm(s)	vlf	very low frequency
ff	flip-flop	n	nano (10 ⁻⁹)	W	watt(s)
freq	frequency	na	not applicable	ww	wire wound
FSN	federal stock number	NC	normally closed	xfmr	transformer
g	gram	(-) or neg	negative	xstr	transistor
G	giga (10 ⁹)	NO	normally open	xtal	crystal
gd	guard	ns	nanosecond	xtlo	crystal oscillator
Ge	germanium	opnl ampl	operational amplifier	Ω	ohm(s)
GHz	gigahertz	p	pico (10 ⁻¹²)	μ	micro (10 ⁻⁶)
gmV	guaranteed minimum value	para	paragraph		
gnd	ground	pcb	printed circuit board		
H	henry	pF	picofarad		
hd	heavy duty	pn	part number		

Federal Supply Codes for Manufacturers

00213 Nytronics Comp. Group Inc. Subsidiary of Nytronics Inc. Formerly Sage Electronics Rochester, New York	02660 Bunker Ramo Corp., Conn Div. Formerly Amphenol-Borg Electric Corp. Broadview, Illinois	04946 Standard Wire & Cable Los Angeles, California	06751 Components, Inc. Semcor Div. Phoenix, Arizona
00327 Welwyn International, Inc. Westlake, Ohio	02799 Areo Capacitors, Inc. Chatsworth, California	05082 Replaced by 94988	06860 Gould Automotive Div. City of Industry, California
00656 Aerovox Corp. New Bedford, Massachusetts	03508 General Electric Co. Semiconductor Products Syracuse, New York	05236 Jonathan Mfg. Co. Fullerton, California	06961 Vernitron Corp., Piezo Electric Div. Formerly Clevite Corp., Piezo Electric Div. Bedford, Ohio
00686 Film Capacitors, Inc. Passaic, New Jersey	03614 Replaced by 71400	05245 Components Corp. now Corcom, Inc. Chicago, Illinois	06980 Eimac Div. Varian Associates San Carlos, California
00779 AMP Inc. Harrisburg, Pennsylvania	03651 Replaced by 44655	05277 Westinghouse Electric Corp. Semiconductor Div. Youngwood, Pennsylvania	07047 The Ross Milton Co. South Hampton, Pennsylvania
01121 Allen-Bradley Co. Milwaukee, Wisconsin	03797 Eldema Div. Genisco Technology Corp. Compton, California	05278 Replaced by 43543	07115 Replaced by 14674
01281 TRW Electronic Comp. Semiconductor Operations Lawndale, California "	03877 Transistron Electronic Corp. Wakefield, Massachusetts	05279 Southwest Machine & Plastic Co. Glendora, California	07138 Westinghouse Electric Corp., Electronic Tube Div. Horsehead, New York
01295 Texas Instruments, Inc. Semiconductor Group Dallas, Texas	03888 KDI Pyrofilm Corp. Whippany, New Jersey	05397 Union Carbide Corp. Materials Systems Div. New York, New York	07233 TRW Electronic Components Cinch Graphic City of Industry, California
01537 Motorola Communications & Electronics Inc. Franklin Park, Illinois	03911 Clairex Electronics Div. Clairex Corp. Mt. Vernon, New York	05571 Use 56289 Sprague Electric Co. Pacific Div. Los Angeles, California	07256 Silicon Transistor Corp. Div. of BBF Group Inc. Chelmsford, Massachusetts
01686 RCL Electronics Inc. Manchester, New Hampshire	03980 Muirhead Inc. Mountainside, New Jersey	05574 Viking Industries Chatsworth, California	07261 Aumet Corp. Culver City, California
01730 Replaced by 73586	04009 Arrow Hart Inc. Hartford, Connecticut	05704 Replaced by 16258	07263 Fairchild Semiconductor Div. of Fairchild Camera & Instrument Corp. Mountain View, California
01884 Use 56289 Sprague Electric Co. Dearborn Electronic Div. Lockwood, Florida	04062 Replaced by 72136	05820 Wakefield Engineering Inc. Wakefield, Massachusetts	07344 Bircher Co., Inc. Rochester, New York
02114 Ferrocube Corp. Saugerties, New York	04202 Replaced by 81312	06001 General Electric Co. Electronic Capacitor & Battery Products Dept. Columbia, South Carolina	07597 Burndy Corp. Tape/Cable Div. Rochester, New York
02131 General Instrument Corp. Harris ASW Div. Westwood, Maine	04217 Essex International Inc. Wire & Cable Div. Anaheim, California	06136 Replaced by 63743	07792 Lerma Engineering Corp. Northampton, Massachusetts
02395 Rason Mfg. Co. Brooklyn, New York	04221 Aemco, Div. of Midtex Inc. Mankato, Minnesota	06383 Panduit Corp. Tinley Park, Illinois	07910 Teledyne Semiconductor Formerly Continental Device Hawthorne, California
02533 Snelgrove, C.R. Co., Ltd. Don Mills, Ontario, Canada M3B 1M2	04222 AVX Ceramics Div. AVX Corp. Myrtle Beach, Florida	06473 Bunker Ramo Corp. Amphenol SAMS Div. Chatsworth, California	07933 Use 49956 Raytheon Co. Semiconductor Div. HQ Mountain View, California
02606 Fenwal Labs Div. of Travenel Labs. Morton Grove, Illinois	04423 Telonic Industries Laguna Beach, California	06555 Beede Electrical Instrument Co. Penacook, New Hampshire	08225 Industro Transistor Corp. Long Island City, New York
	04645 Replaced by 75376	06739 Electron Corp. Littleton, Colorado	
	04713 Motorola Inc. Semiconductor Products Phoenix, Arizona	06743 Clevite Corp. Cleveland, Ohio	

Federal Supply Codes for Manufacturers (cont)

08261 Spectra Strip Corp. Garden Grove, California	11726 Qualidyne Corp. Santa Clara, California	13606 Use 56289 Sprague Electric Co. Transistor Div. Concord, New Hampshire	16299 Corning Glass Electronic Components Div. Raleigh, North Carolina
08530 Reliance Mica Corp. Brooklyn, New York	12014 Chicago Rivet & Machine Co. Bellwood, Illinois	13839 Replaced by 23732	16332 Replaced by 28478
08806 General Electric Co. Miniature Lamp Products Dept Cleveland, Ohio	12040 National Semiconductor Corp. Danbury, Connecticut	14099 Semtech Corp. Newbury Park, California	16473 Cambridge Scientific Ind. Div. of Chemed Corporation Cambridge, Maryland
08863 Nylomatic Corp. Norrisville, Pennsylvania	12060 Diodes, Inc. Chatsworth, California	14140 Edison Electronic Div. Mc Gray-Edison Co. Manchester, New Hampshire	16742 Paramount Plastics Fabricators, Inc. Downey, California
08988 Use 53085 Skottie Electronics Inc. Archbald, Pennsylvania	12136 Philadelphia Handle Co. Camden, New Jersey	14193 Cal-R-Inc. formerly California Resistor, Corp. Santa Monica, California	16758 Delco Electronics Div. of General Motors Corp. Kokomo, Indiana
09214 G.E. Co. Semi-Conductor Products Dept. Power Semi-Conductor Products OPN Sec. Auburn, New York	12300 Potter-Brumfield Div. AMF Canada LTD. Guelph, Ontario, Canada	14298 American Components, Inc. an Insilco Co. Conshohocken, Pennsylvania	17001 Replaced by 71468
09353 C and K Components Watertown, Massachusetts	12323 Presin Co., Inc. Shelton, Connecticut	14655 Cornell-Dublier Electronics Division of Federal Pacific Electric Co. Govt. Control Dept. Newark, New Jersey	17069 Circuit Structures Lab. Burbank, California
09423 Scientific Components, Inc. Santa Barbara, California	12327 Freeway Corp. formerly Freeway Washer & Stamping Co. Cleveland, Ohio	14752 Electro Cube Inc. San Gabriel, California	17338 High Pressure Eng. Co., Inc. Oklahoma City, Oklahoma
09922 Burndy Corp. Norwalk, Connecticut	12443 The Budd Co. Polychem Products Plastic Products Div. Bridgeport, Pennsylvania	14869 Replaced by 96853	17545 Atlantic Semiconductors, Inc. Asbury Park, New Jersey
09969 Dale Electronics Inc. Yankton, S. Dakota	12615 U.S. Terminals Inc. Cincinnati, Ohio	14936 General Instrument Corp. Semi Conductor Products Group Hicksville, New York	17856 Siliconix, Inc. Santa Clara, California
10059 Barker Engineering Corp. Formerly Amerace, Amerace ESNA Corp. Kenilworth, New Jersey	12617 Hamlin Inc. Lake Mills, Wisconsin	15636 Elec-Trol Inc. Saugus, California	17870 Replaced by 14140
11236 CTS of Berne Berne, Indiana	12697 Clarostat Mfg. Co. Dover, New Hampshire	15801 Fenwal Electronics Inc. Div. of Kidde Walter and Co., Inc. Framingham, Massachusetts	18178 Vactec Inc. Maryland Heights, Missouri
11237 CTS Keene Inc. Paso Robles, California	12749 James Electronics Chicago, Illinois	15818 Teledyne Semiconductors, formerly Amelco Semiconductor Mountain View, California	18324 Signetics Corp. Sunnyvale, California
11358 CBS Electronic Div. Columbia Broadcasting System Newburyport, Minnesota	12856 Micrometals Sierra Madre, California	15849 Litton Systems Inc. Useco Div. formerly Useco Inc. Van Nuys, California	18612 Vishay Resistor Products Div. Vishay Intertechnology Inc. Malvern, Pennsylvania
11403 Best Products Co. Chicago, Illinois	12954 Dickson Electronics Corp. Scottsdale, Arizona	15898 International Business Machines Corp. Essex Junction, Vermont	18736 Voltronics Corp. Hanover, New Jersey
11503 Keystone Columbia Inc. Warren, Michigan	12969 Unitrode Corp. Watertown, Massachusetts	15909 Replaced by 14140	18927 GTE Sylvania Inc. Precision Material Group Parts Division Titusville, Pennsylvania
11532 Teledyne Relays Hawthorne, California	13103 Thermalloy Co., Inc. Dallas, Texas	16258 Space-Lok Inc. Burbank, California	19451 Perine Machinery & Supply Co. Seattle, Washington
11711 General Instrument Corp. Rectifier Division Hicksville, New York	13327 Solitron Devices Inc. Tappan, New York		19701 Electro-Midland Corp. Mepco-Electra Inc. Mineral Wells, Texas
	13511 Amphenol Cadre Div. Bunker-Ramo Corp. Los Gatos, California		20584 Enochs Mfg. Inc. Indianapolis, Indiana

Federal Supply Codes for Manufacturers (cont)

20891 Self-Organizing Systems, Inc. Dallas, Texas	28480 Hewlett Packard Co. Corporate HQ Palo Alto, California	43543 Nytronics Inc. Transformer Co. Div. Geneva, New York	70903 Belden Corp. Geneva, Illinois
21604 Bucheys Stamping Co. Columbus, Ohio	28520 Heyman Mfg. Co. Kenilworth, New Jersey	44655 Ohmite Mfg. Co. Skokie, Illinois	71002 Birnbach Radio Co., Inc. Freeport, New York
21845 Solitron Devices Inc. Transistor Division Riveria Beach, Florida	29083 Monsanto, Co., Inc. Santa Clara, California	49671 RCA Corp. New York, New York	71400 Bussmann Mfg. Div. of McGraw-Edison Co. Saint Louis, Missouri
22767 ITT Semiconductors Palo Alto, California	29604 Stackpole Components Co. Raleigh, North Carolina	49956 Raytheon Company Lexington, Massachusetts	71450 CTS Corp. Elkhart, Indiana
23050 Product Comp. Corp. Mount Vernon, New York	30148 AB Enterprise Inc. Ahoskie, North Carolina	50088 Mostek Corp. Carrollton, Texas	71468 ITT Cannon Electric Inc. Santa Ana, California
23732 Tracor Inc. Rockville, Maryland	30323 Illinois Tool Works, Inc. Chicago, Illinois	50579 Litronix Inc. Cupertino, California	71482 Clare, C.P. & Co. Chicago, Illinois
23880 Stanford Applied Engrng. Santa Clara, California	31091 Optimax Inc. Colmar, Pennsylvania	51605 Scientific Components Inc. Linden, New Jersey	71590 Centrelab Electronics Div. of Globe Union Inc. Milwaukee, Wisconsin
23936 Pamotor Div., Wm. J. Purdy Co. Burlingame, California	32539 Mura Corp. Great Neck, New York	53021 Sangamo Electric Co. Springfield, Illinois	71707 Coto Coil Co., Inc. Providence, Rhode Island
24248 Replaced by 94222	32767 Griffith Plastic Corp. Burlingame, California	54294 Cutler-Hammer Inc. formerly Shallcross, A Cutter-Hammer Co. Selma, North Carolina	71744 Chicago Miniature Lamp Works Chicago, Illinois
24355 Analog Devices Inc. Norwood, Massachusetts	32879 Advanced Mechanical Components Northridge, California	55026 Simpson Electric Co. Div. of Am. Gage and Mach. Co. Elgin, Illinois	71785 TRW Electronics Components Cinch Connector Operations Div. Elk Grove Village Chicago, Illinois
24655 General Radio Concord, Massachusetts	32897 Erie Technological Products, Inc. Frequency Control Div. Carlisle, Pennsylvania	56289 Sprague Electric Co. North Adams, Massachusetts	72005 Wilber B. Driver Co. Newark, New Jersey
24759 Lenox-Fugle Electronics Inc. South Plainfield, New Jersey	32997 Bourns Inc. Trimpot Products Division Riverside, California	58474 Superior Electric Co. Bristol, Connecticut	72092 Replaced by 06980
25088 Siemen Corp. Isilen, New Jersey	33173 General Electric Co. Products Dept. Owensboro, Kentucky	60399 Torin Corp. formerly Torrington Mfg. Co. Torrington, Connecticut	72136 Electro Motive Mfg. Co. Williamantic, Connecticut
25403 Amperex Electronic Corp. Semiconductor & Micro-Circuits Div. Slatersville, Rhode Island	34333 Silicon General Westminster, California	63743 Ward Leonard Electric Co., Inc. Mount Vernon, New York	72259 Nytronics Inc. Pelham Manor, New Jersey
27014 National Semiconductor Corp. Santa Clara, California	34335 Advanced Micro Devices Sunnyvale, California	64834 West Mfg. Co. San Francisco, California	72619 Dialight Div. Amperex Electronic Corp. Brooklyn, New York
27264 Molex Products Downers Grove, Illinois	34802 Electromotive Inc. Kenilworth, New Jersey	65092 Weston Instruments Inc. Newark, New Jersey	72653 G.C. Electronics Div. of Hydrometals, Inc. Brooklyn, New York
28213 Minnesota Mining & Mfg. Co. Consumer Products Div. St. Paul, Minnesota	37942 P.R. Mallory & Co., Inc. Indianapolis, Indiana	66150 Winslow Tele-Tronics Inc. Eaton Town, New Jersey	72665 Replaced by 90303
28425 Serv.-Link formerly Bohannon Industries Fort Worth, Texas	42498 National Radio Melrose, Massachusetts	70485 Atlantic India Rubber Works Chicago, Illinois	72794 Dzus Fastener Co., Inc. West Islip, New York
28478 Deltrol Controls Div. Deltrol Corporation Milwaukee, Wisconsin		70563 Amperite Company Union City, New Jersey	72928 Gulton Ind. Inc. Gudeman Div. Chicago, Illinois

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72982 Erie Tech. Products Inc. Erie, Pennsylvania	75382 Kulka Electric Corp. Mount Vernon, New York	80583 Hammarlund Mfg. Co., Inc. Red Bank, New Jersey	83594 Burrhoughs Corp. Electronic Components Div. Plainfield, New Jersey
73138 Bechman Instrument Inc. Helipot Division Fullerton, California	75915 Littlefuse Inc. Des Plaines, Illinois	80640 Arnold Stevens, Inc. South Boston, Massachusetts	83740 Union Carbide Corp. Battery Products Div. formerly Consumer Products Div. New York, New York
73293 Hughes Aircraft Co. Electron Dynamics Div. Torrance, California	76854 Oak Industries Inc. Switch Div. Crystal Lake, Illinois	81073 Grayhill, Inc. La Grange, Illinois	84171 Arco Electronics Great Neck, New York
73445 Amperex Electronic Corp. Hicksville, New York	77342 AMF Inc. Potter & Brumfield Div. Princeton, Indiana	81312 Winchester Electronics Div. of Litton Industries Inc. Oakville, Connecticut	84411 TRW Electronic Components TRW Capacitors Ogallala, Nebraska
73559 Carling Electric Inc. West Hartford, Connecticut	77638 General Instrument Corp. Rectifier Division Brooklyn, New York	81483 Therm-O-Disc Inc. Mansfield, Ohio	84613 Fuse Indicator Corp. Rockville, Maryland
73586 Circle F Industries Trenton, New Jersey	77969 Rubbercraft Corp. of CA. LTD. Torrance, California	81483 International Rectifier Corp. Los Angeles, California	84682 Essex International Inc. Industrial Wire Div. Peabody, Massachusetts
73734 Federal Screw Products, Inc. Chicago, Illinois	78189 Shakeproof Div. of Illinois Tool Works Inc. Elgin, Illinois	81590 Korby Mfg. Co. Seattle, Washington	86577 Precision Metal Products of Malden Inc. Stoneham, Massachusetts
73743 Fischer Special Mfg. Co. Cincinnati, Ohio	78277 Sigma Instruments, Inc. South Braintree, Massachusetts	81741 Chicago Lock Co. Chicago, Illinois	86684 Radio Corp. of America Electronic Components Div. Harrison, New Jersey
73899 JFD Electronics Co. Components Corp. Brooklyn, New York	78488 Stackpole Carbon Co. Saint Marys, Pennsylvania	82305 Palmer Electronics Corp. South Gate, California	86928 Seastrom Mfg. Co., Inc. Glendale, California
73949 Guardian Electric Mfg. Co. Chicago, Illinois	78553 Eaton Corp. Engineered Fastener Div. Tinnerman Plant Cleveland, Ohio	82389 Switchcraft Inc. Chicago, Illinois	87034 Illuminated Products Inc. Subsidiary of Oak Industries Inc. Anaheim, California
74199 Quan Nichols Co. Chicago, Illinois	79136 Waldes Kohinoor Inc. Long Island City, New York	82415 North American Phillips Controls Corp. Frederick, Maryland	88219 Gould Inc. Industrial Div. Trenton, New Jersey
74217 Radio Switch Corp. Marlboro, New Jersey	79497 Western Rubber Company Goshen, Indiana	82872 Roanwell Corp. New York, New York	88245 Litton Systems Inc. Usco Div. Van Nuys, California
74276 Signalite Div. General Instrument Corp. Neptune, New Jersey	79963 Zierick Mfg. Corp. Mt. Kisko, New York	82877 Rotron Inc. Woodstock, New York	88419 Cornell-Dubilier Electronic Div. Federal Pacific Co. Fuquay-Varian, North Carolina
74306 Piezo Crystal Co. Carlisle, Pennsylvania	80031 Electro-Midland Corp. Mepco Div. A North American Phillips Co. Norristown, New Jersey	82879 ITT Royal Electric Div. Pawtucket, Rhode Island	88486 Plastic Wire & Cable Jewett City, Connecticut
74542 Hoyt Elect. Instr. Works Penacook, New Hampshire	80145 LFE Corp., Process Control Div. formerly API Instrument Co. Chesterland, Ohio	83003 Varo Inc. Garland, Texas	88690 Replaced by 04217
74970 Johnson E.F., Co. Waseca, Minnesota	80183 Use 56289 Sprague Products North Adams, Massachusetts	83058 The Carr Co., United Can Div. of TRW Cambridge, Massachusetts	89536 John Fluke Mfg. Co., Inc. Seattle, Washington
75042 TRW Electronics Components IRC Fixed Resistors Philadelphia, Pennsylvania	80294 Bourns Inc., Instrument Div. Riverside, California	83298 Bendix Corp. Electric Power Div. Eatontown, New Jersey	89730 G.E. Co., Newark Lamp Works Newark, New Jersey
75376 Kurz-Kasch Inc. Dayton, Ohio		83330 Herman H. Smith, Inc. Brooklyn, New York	
75378 CTS Knights Inc. Sandwich, Illinois		83478 Rubbercraft Corp. of America, Inc. West Haven, Connecticut	

Federal Supply Codes for Manufacturers (cont)

90201 Mallory Capacitor Co. Div. of P.R. Mallory Co., Inc. Indianapolis, Indiana	91836 King's Electronics Co., Inc. Tuckahoe, New York	95354 Methode Mfg. Corp. Rolling Meadows, Illinois	98291 Sealectro Corp. Mamaroneck, New York
90211 Use 56365 Square D Co. Chicago, Illinois	91929 Honeywell Inc. Micro Switch Div. Freeport, Illinois	95712 Bendix Corp. Electrical Components Div. Microwave Devices Plant Franklin, Indiana	98388 Royal Industries Products Div. San Diego, California
90215 Best Stamp & Mfg. Co. Kansas City, Missouri	91934 Miller Electric Co., Inc. Div. of Aunet Woonsocket, Rhode Island	95987 Weckesser Co. Inc. Chicago, Illinois	98743 Replaced by 12749
90303 Mallory Battery Co. Div. of Mallory Co., Inc. Tarrytown, New York	92194 Alpha Wire Corp. Elizabeth, New Jersey	96733 San Fernando Electric Mfg. Co. San Fernando, California	98925 Replaced by 14433
91094 Essex International Inc. Suglex/IWP Div. Newmarket, New Hampshire	93332 Sylvania Electric Products Semiconductor Products Div. Woburn, Massachusetts	96853 Gulton Industries Inc. Measurement and Controls Div. formerly Rustrak Instruments Co. Manchester, New Hampshire	99120 Plastic Capacitors, Inc. Chicago, Illinois
91293 Johanson Mfg. Co. Boonton, New Jersey	94145 Replaced by 49956	96881 Thomson Industries, Inc. Manhasset, New York	99217 Bell Industries Elect. Comp. Div. formerly Southern Elect. Div. Burbank, California
91407 Replaced by 58474	94154 Use 94988 Wagner Electric Corp. Tung-Sol Div. Newark, New Jersey	97540 Master Mobile Mounts, Div. of Whitehall Electronics Corp. Ft. Meyers, Florida	99392 STM Oakland, California
91502 Associated Machine Santa Clara, California	94222 Southco Inc. formerly South Chester Corp. Lester, Pennsylvania	97913 Industrial Electronic Hardware Corp. New York, New York	99515 ITT Jennings Monrovia Plant Div. of ITT Jennings formerly Marshall Industries Capacitor Div. Monrovia, California
91506 Augat Inc. Attleboro, Massachusetts	95146 Alco Electronic Products Inc. Lawrence, Massachusetts	97945 Penwalt Corp. SS White Industrial Products Div. Piscataway, New Jersey	99779 Use 29587 Bunker-Ramo Corp. Barnes Div. Landsdowne, Pennsylvania
91637 Dale Electronics Inc. Columbus, Nebraska	95263 Leecraft Mfg. Co. Long Island City, New York	97966 Replaced by 11358	99800 American Precision Industries Inc. Delevan Division East Aurora, New York
91662 Elco Corp. Willow Grove, Pennsylvania	95264 Replaced by 98278	98094 Replaced by 49956	99942 Centrelab Semiconductor Centrelab Electronics Div. of Globe-Union Inc. El Monte, California
91737 Use 71468 Gremar Mfg. Co., Inc. ITT Cannon/Gremar Santa Ana, California	95275 Vitramon Inc. Bridgeport, Connecticut	98159 Rubber-Teck, Inc. Gardena, California	Toyo Electronics (R-Ohm Corp.) Irvine, California
91802 Industrial Devices, Inc. Edgewater, New Jersey	95303 RCA Corp. Receiving Tube Div. Cincinnati, Ohio	98278 Malco A Microdot Co., Inc. Connector & Cable Div. Pasadena, California	National Connector Minneapolis, Minnesota
91833 Keystone Electronics Corp. New York, New York	95348 Gordo's Corp. Bloomfield, New Jersey		

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Section 8

Schematic Diagrams

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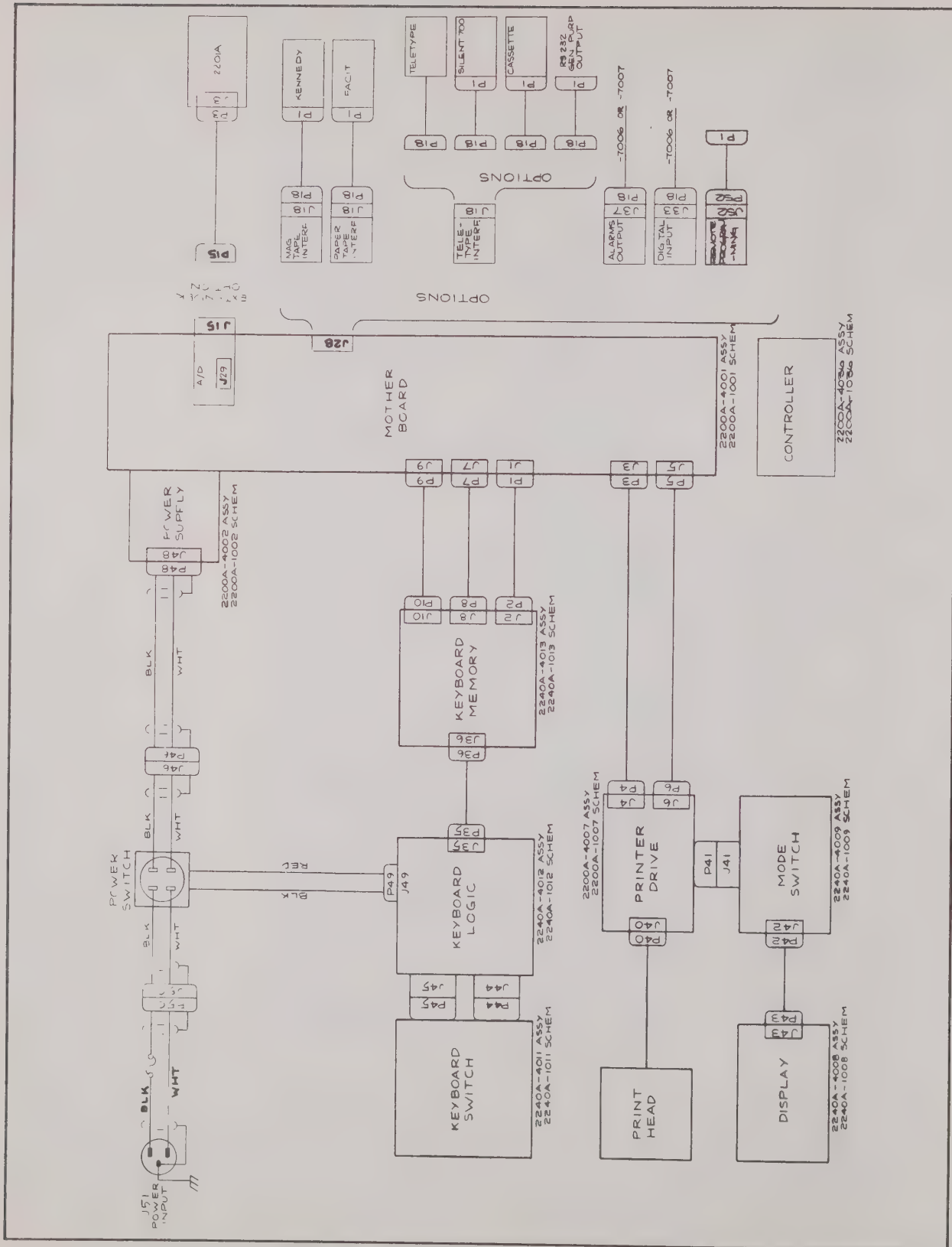


Figure 8-1. System Cable Connections (2240B-1301) (Sheet 1 of 2)

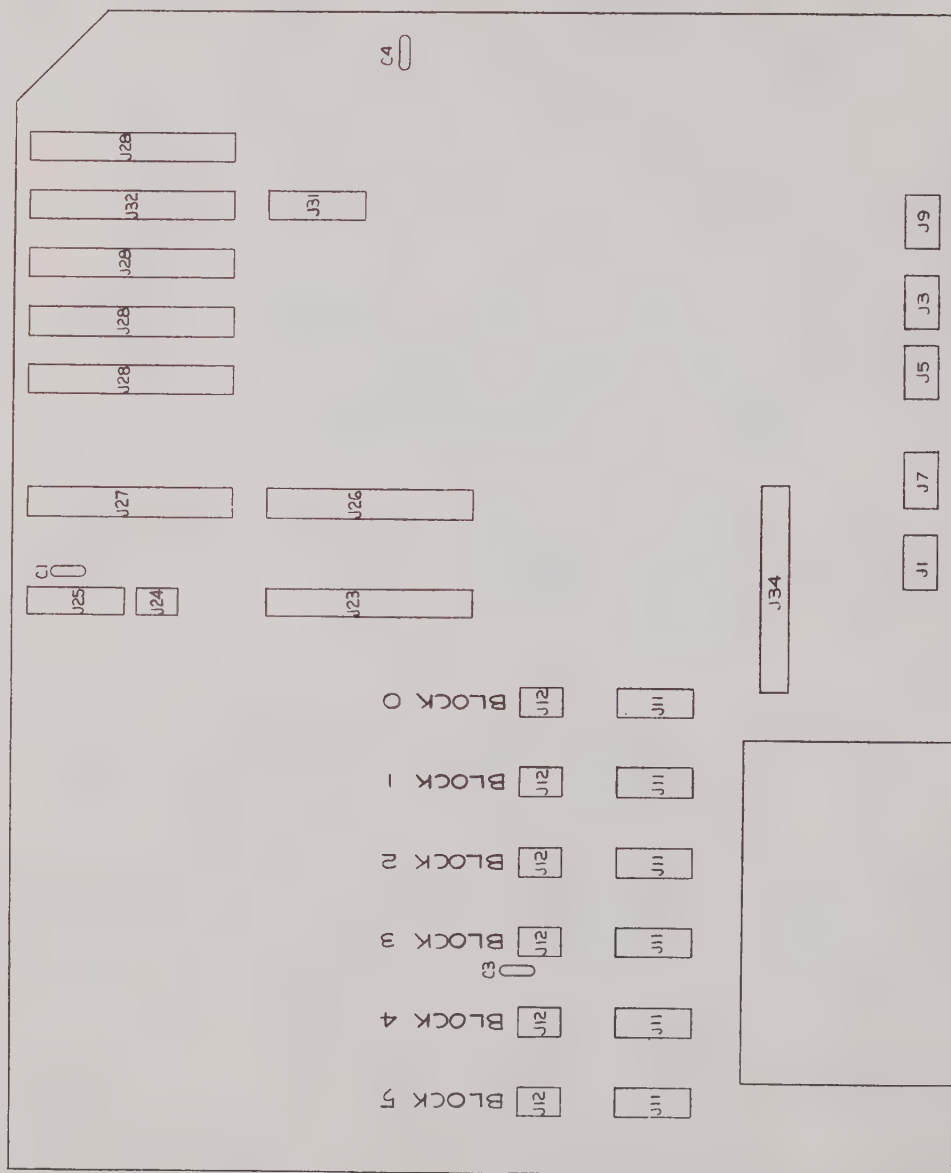


Figure 8-2. A1 Mother Board PCB Assembly (2200A-1001) (Sheet 1 of 2)

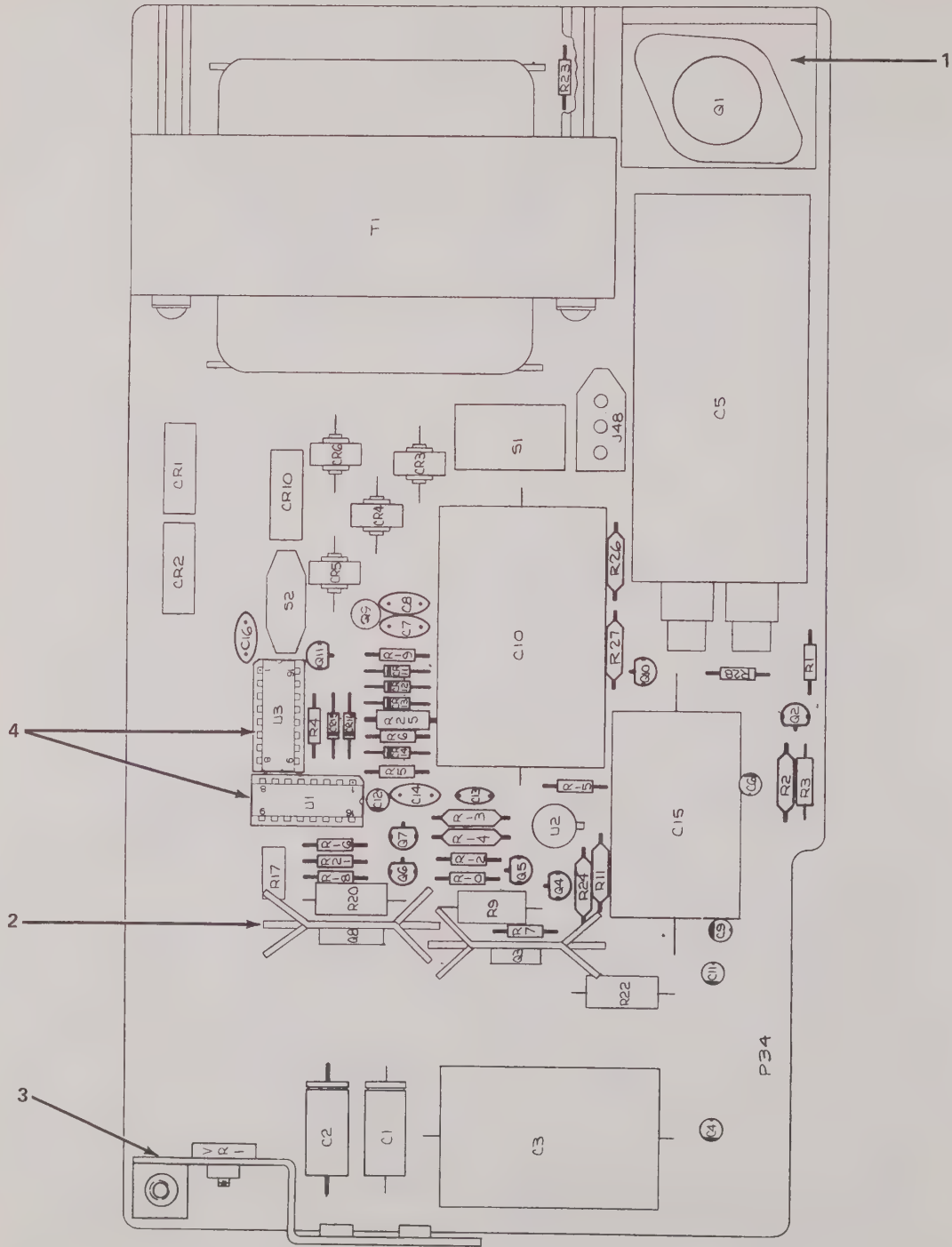


Figure 8-3. A2 Power Supply PCB Assembly (2200A-1002) (Sheet 1 of 2)

REF. DES.	QIN NO.	QIN NO. NOT USED	REFERENCE DESIGNATIONS
U1	1/6	8	CR16
			VR2
			CR7-9
			CR15
			RB
			TP9

- NOTES:
- UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
 - FOR ASSEMBLY DRAWING SEE 2200A-4002.
 - Q DENOTES CALIBRATION ADJ. POINTS, ALL POINTS ARE SCREWDRIVER ADJUST.
 - ALL RESISTORS ARE 1/4 W, 1% UNLESS OTHERWISE SPECIFIED.
 - ALL CAPACITORS ARE IN ACCORDANCE WITH ANSI Y32.14 AND Y32.2.
 - 1-5V DENOTES GUARDED LOGIC COMMON (UL COM F9W).
 - UL COM DENOTES LOGIC COMMON, TO A/D COM.
 - UL COM DENOTES LOGIC COMMON.
 - ALL VOLTAGES NOTED WITHIN GUARDED SECTION OF INSTRUMENT ARE WITH RESPECT TO A/D COM.

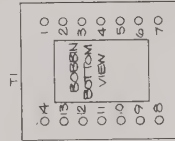
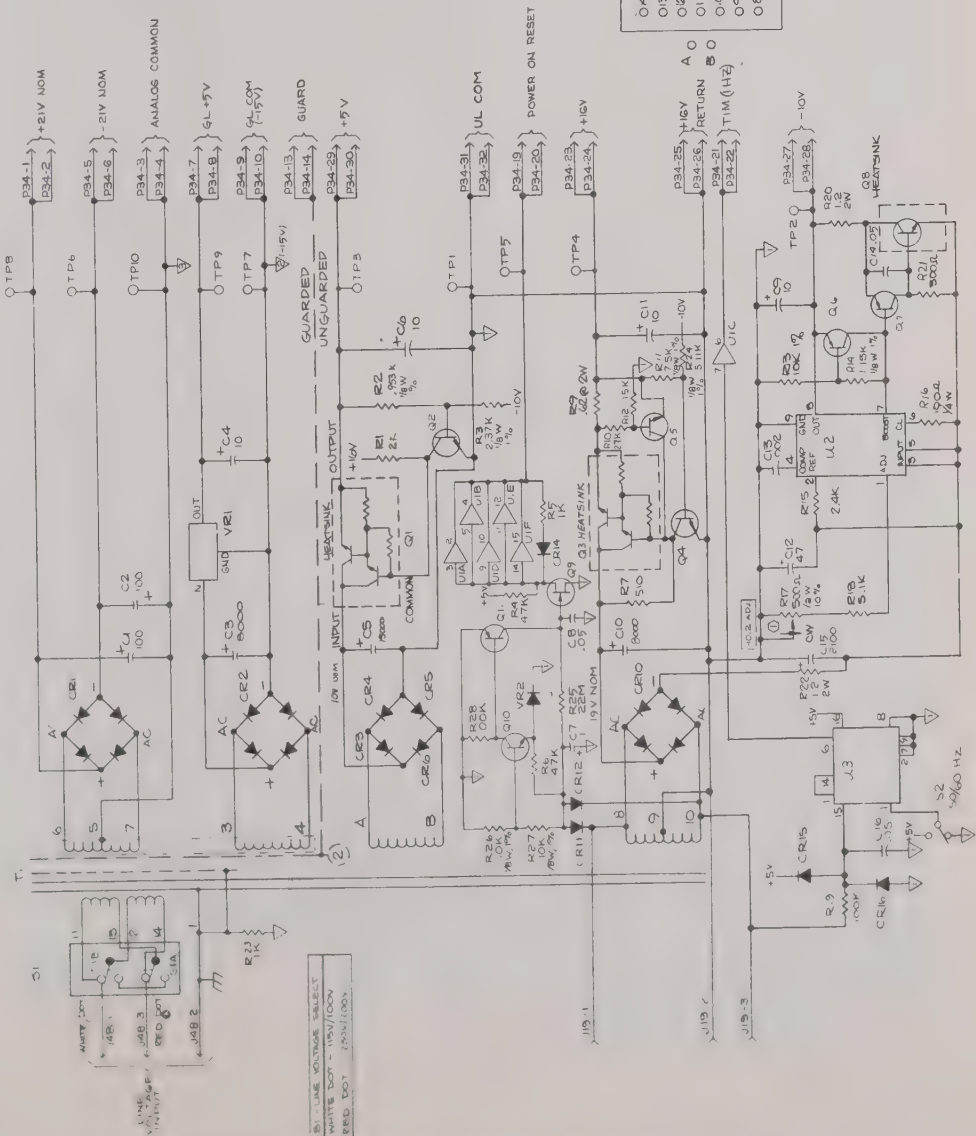


Figure 8-3. A2 Power Supply PCB Assembly (2200A-1002) (Sheet 2 of 2)

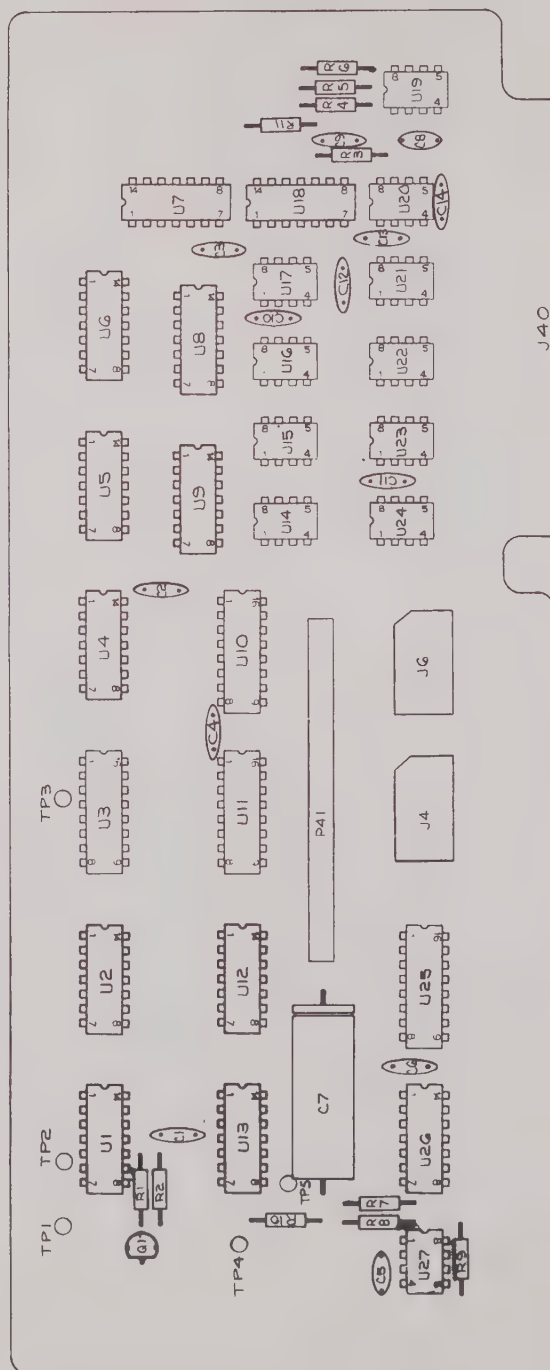


Figure 8-4. A5 Printer Drive PCB Assembly (2200A-1007) (Sheet 1 of 2)

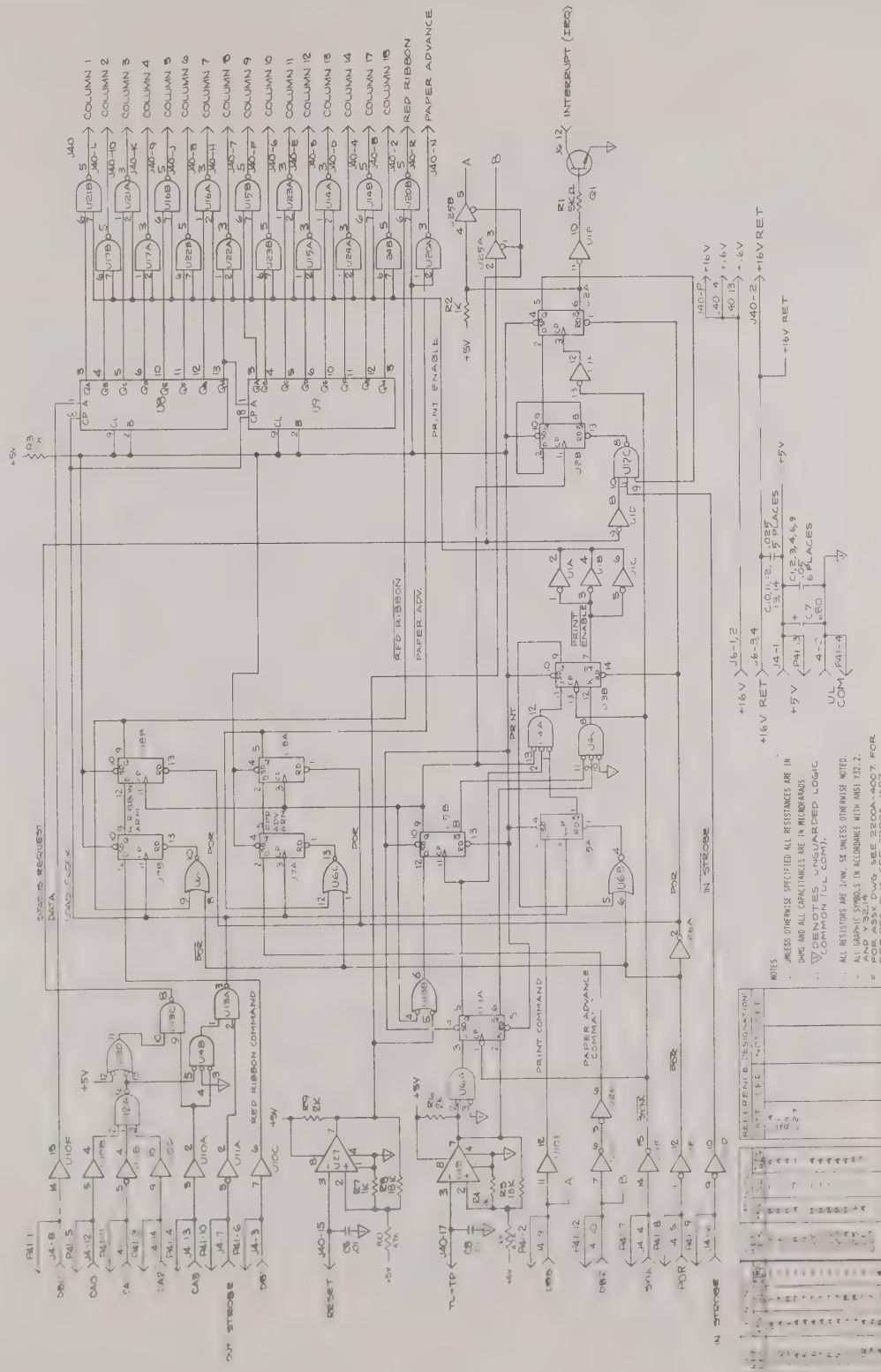


Figure 8-4. A5 Printer Drive PCB Assembly (2200A-1007) (Sheet 2 of 2)

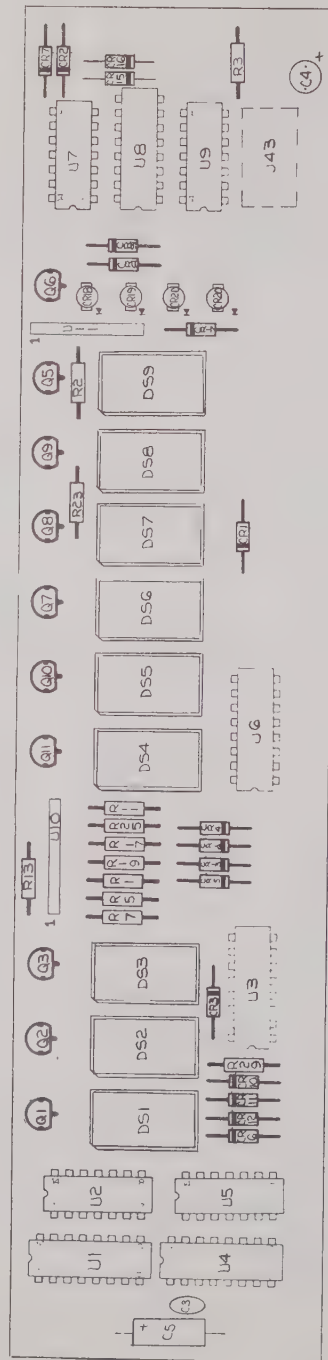


Figure 8-5. A6 Display PCB Assembly (2240A-1008) (Sheet 1 of 2)

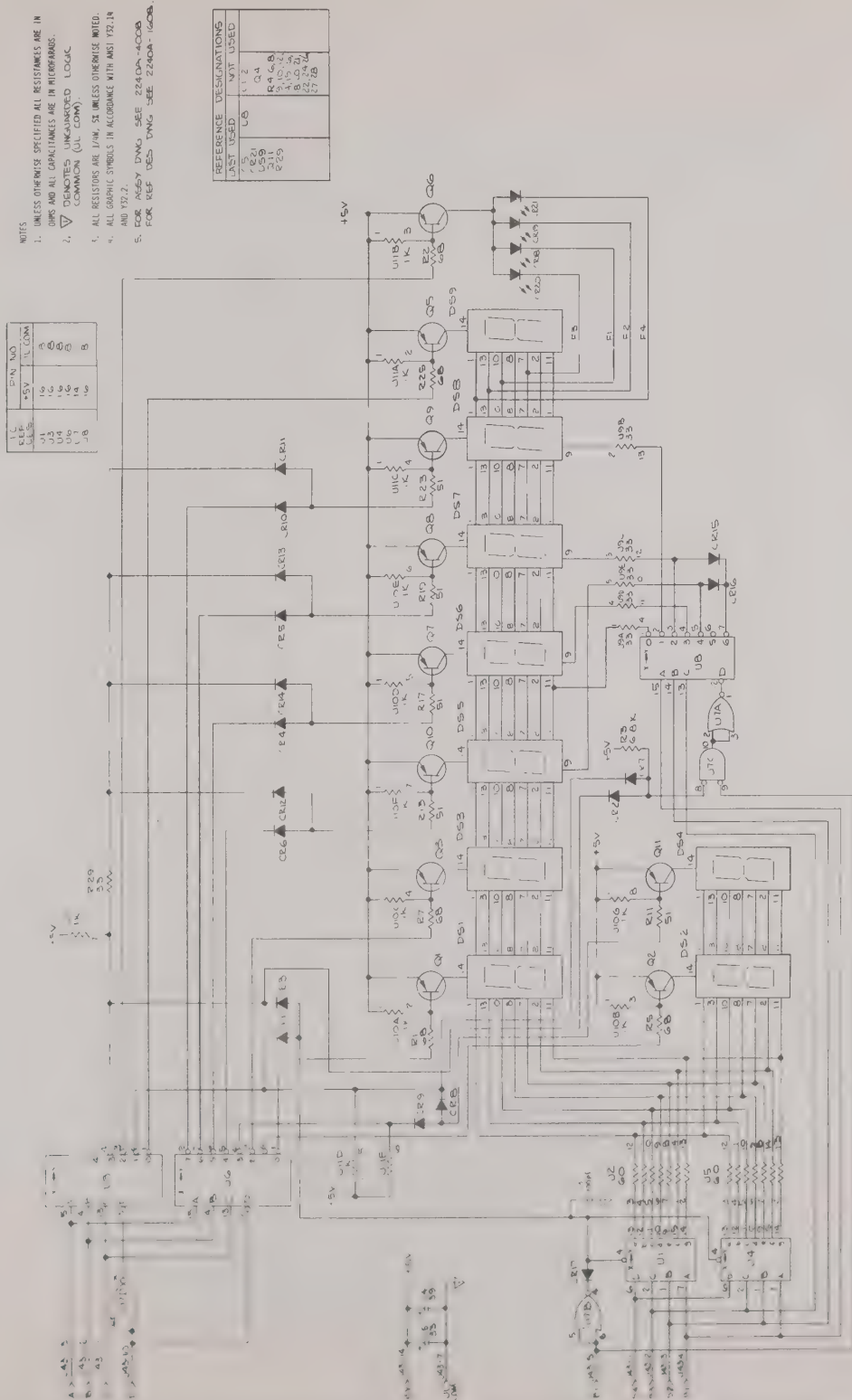


Figure 8-5. A6 Display PCB Assembly (2240A-1008) (Sheet 2 of 2)

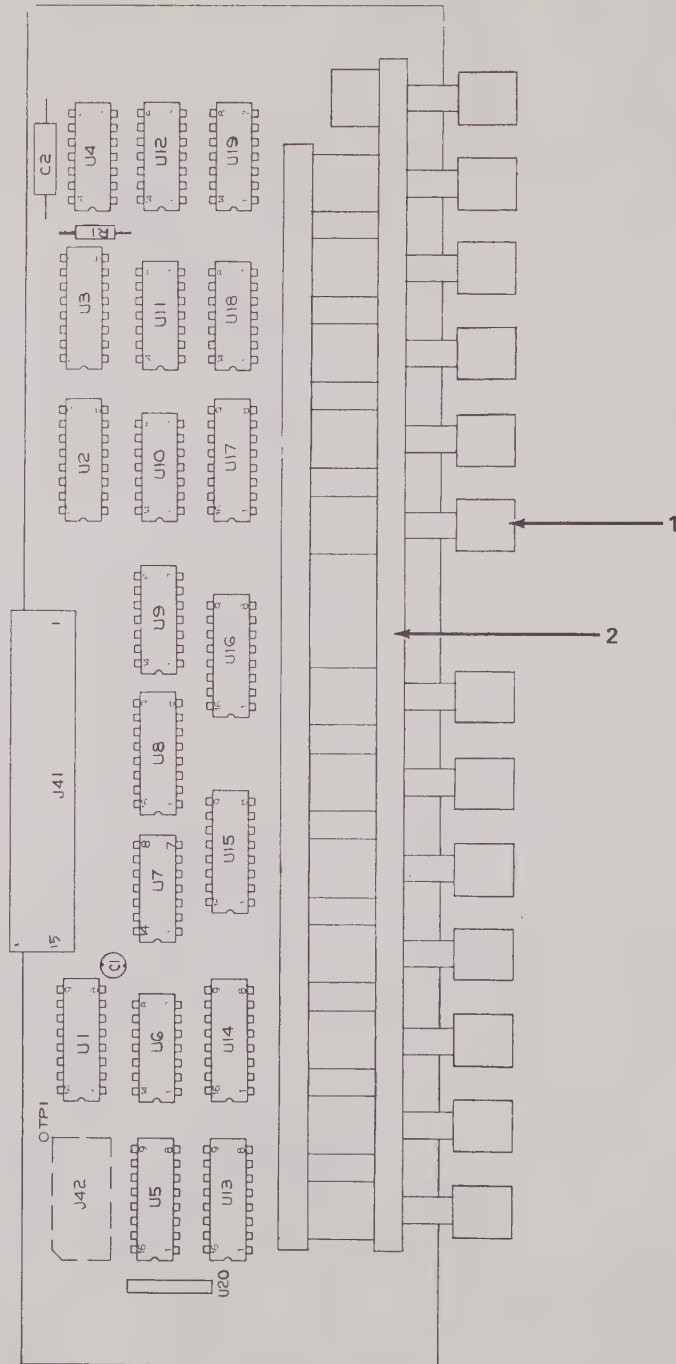


Figure 8-6. A7 Mode Switch PCB Assembly (2240A-1009) (Sheet 1 of 2)

- NOTES
- FOR ASSEMBLY DWG SEE 2240A-1009
 - ALL GRAPHIC SYMBOLS ARE IN ACCORDANCE WITH 192.4 AND 192.2.
 - W/ DENOTES UNGUARDED COMMON
 - UL COM
 - ALL RESISTANCES ARE IN OHMS AND UNLESS OTHERWISE SPECIFIED, RESET SWITCH SHOWN IN DEPRESS POSITION. OTHER SWITCHES SHOWN IN NONDEPRESSED POSITION.

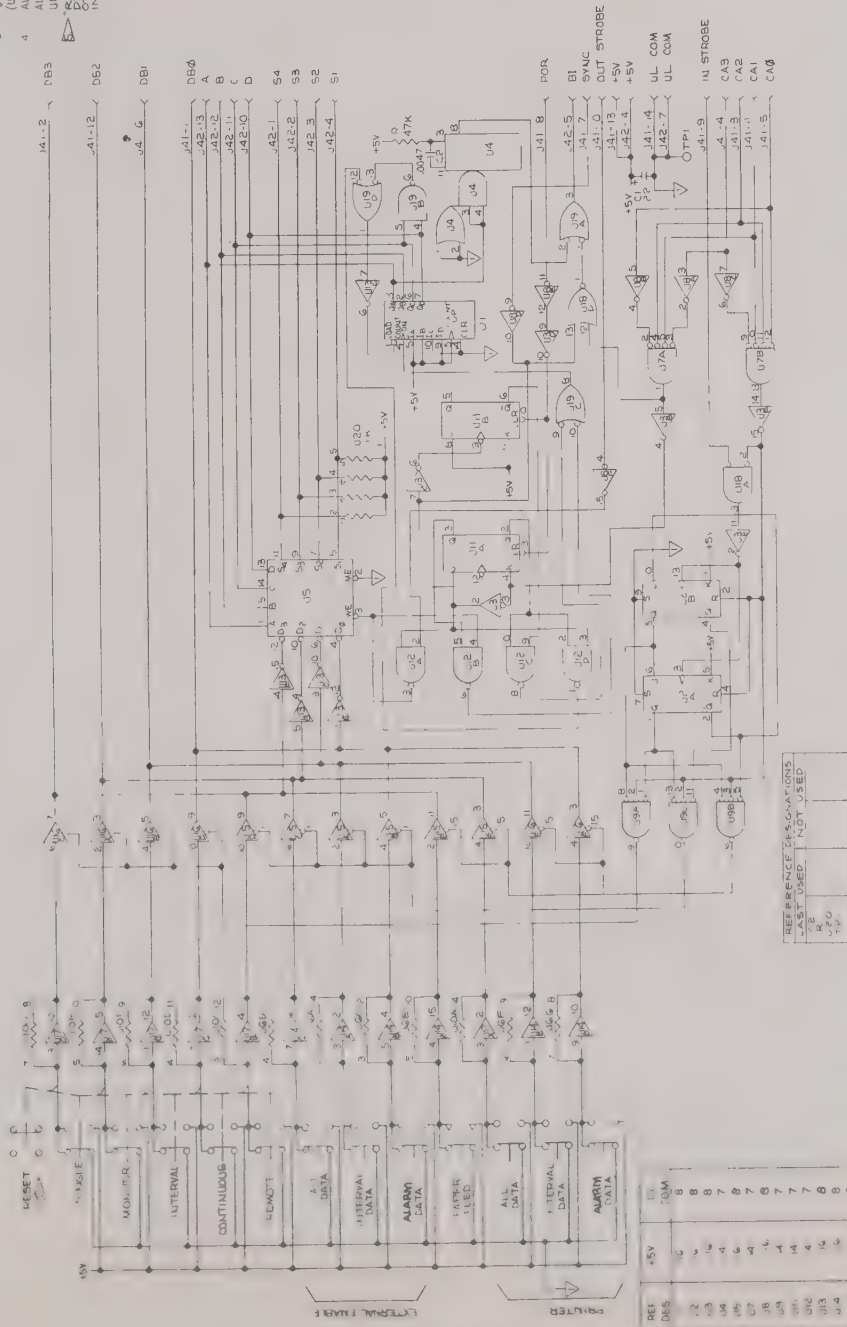


Figure 8-6. A7 Mode Switch PCB Assembly (2240A-1009) (Sheet 2 of 2)

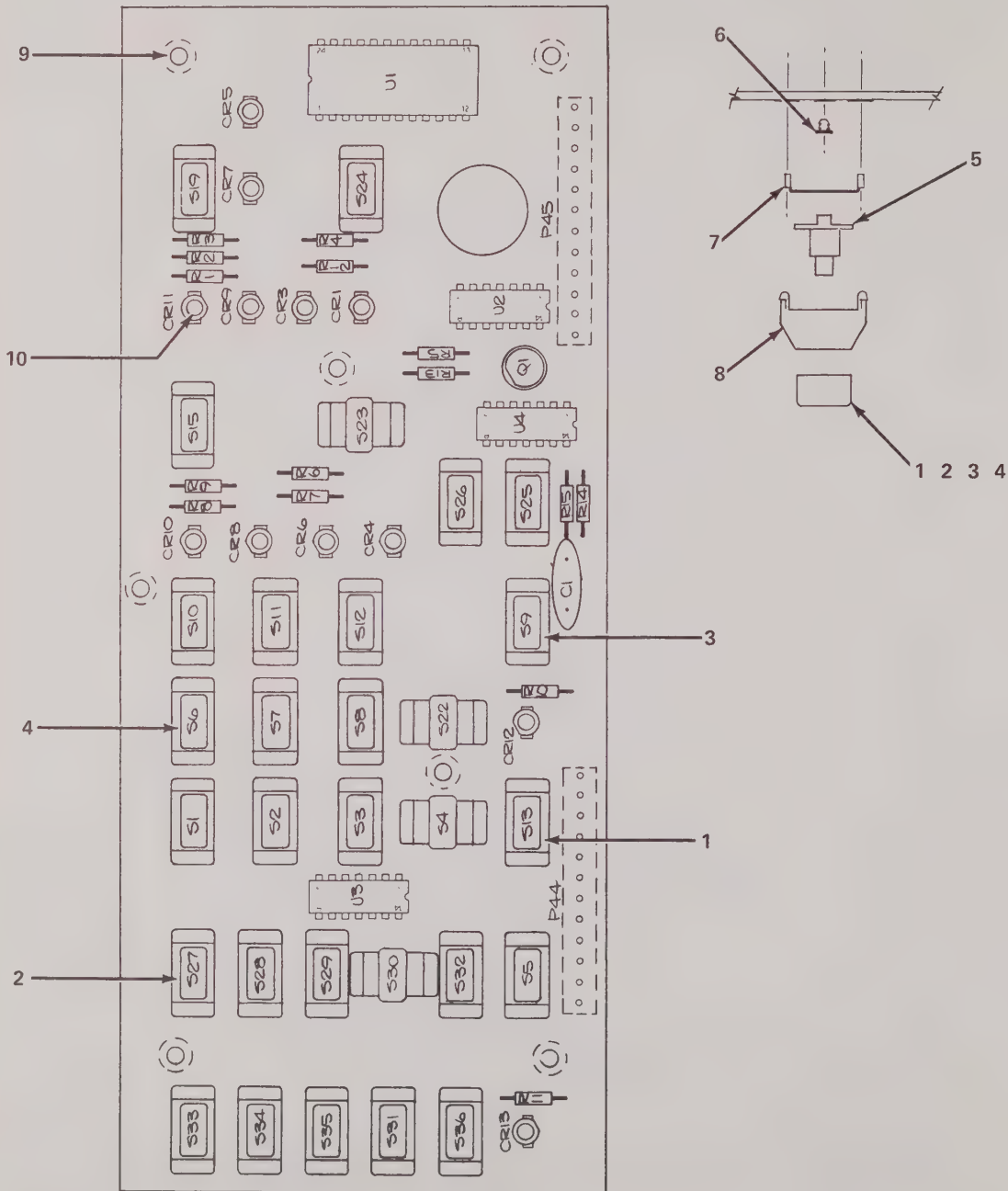


Figure 8-7. A8 Keyboard Switch PCB Assembly (2240A-1011) (Sheet 1 of 2)

- NOTES
1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
 2. ∇ DENOTES UNGUARDED LOGIC.
 3. ALL RESISTORS (UNLESS OTHERWISE NOTED, RESISTANCE IS 1% TOLERANCE) ARE 1/4 WATT.
 4. ALL GRAPHIC SYMBOLS IN ACCORDANCE WITH ANSI Y32.1A.
 5. FOR SERV DWG SEE 2240A-4011. FOR REF DES. DWG SEE 2240A-1611.

IC	PIN NO
REF DES	1 SV 1251A
U1	24 12 18
U2	14 7
U3	14 7
U4	14 7

REFERENCE DESIGNATION	LAST USED	EXCLUDED
R15	537	CR2
R16	538	CR3
R17	539	U4

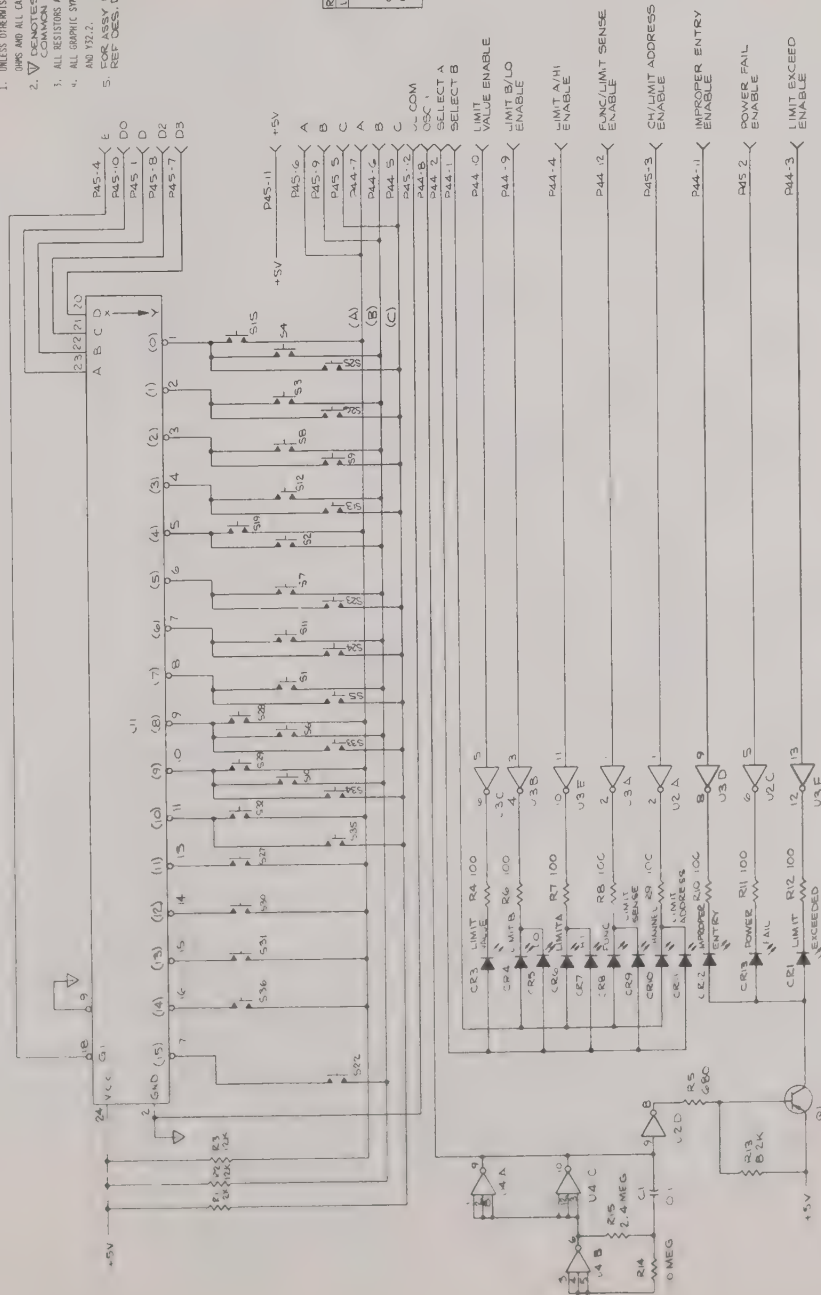


Figure 8-7. A8 Keyboard Switch PCB Assembly (2240A-1011) (Sheet 2 of 2)

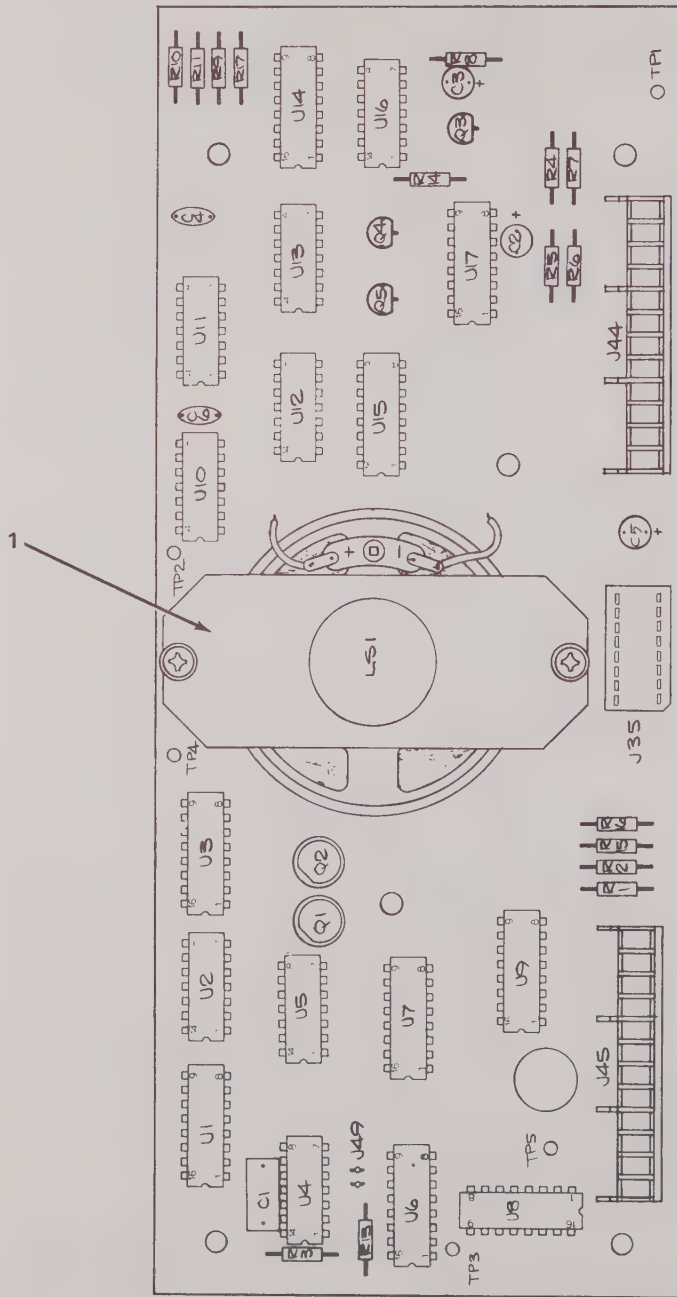


Figure 8-8. A9 Keyboard Logic PCB Assembly (2240A-1012) (Sheet 1 of 2)

- NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
 2. ∇ DENOTES UNGUARDED LOGIC
 3. ALL RESISTORS ARE 1/4W. ∇ UNLESS OTHERWISE NOTED
 4. ALL GRAPHIC SYMBOLS IN ACCORDANCE WITH ANSI Y32.14 AND Y32.2.
 5. FOR ASSY DWG SEE 2240A-1012, FOR REF DES DWG SEE 2240A-1012.

IC	REF	DATA	NO.
U1	U1	16	8
U2	U2	14	7
U3	U3	6	8
U4	U4	14	7
U5	U5	14	6,8
U6	U6	16	8
U7	U7	16	8
U8	U8	12	7
U9	U9	12	7
U10	U10	14	7
U11	U11	2,4,4,7,9	
U12	U12	14	7
U13	U13	14	7
U14	U14	16	8
U15	U15	5	12
U16	U16	14	7
U17	U17	16	8

SUBCIRCUIT DESIGNATIONS
U17 USED
U12 NOT USED
U16
U17
U15
U14
U13
U12

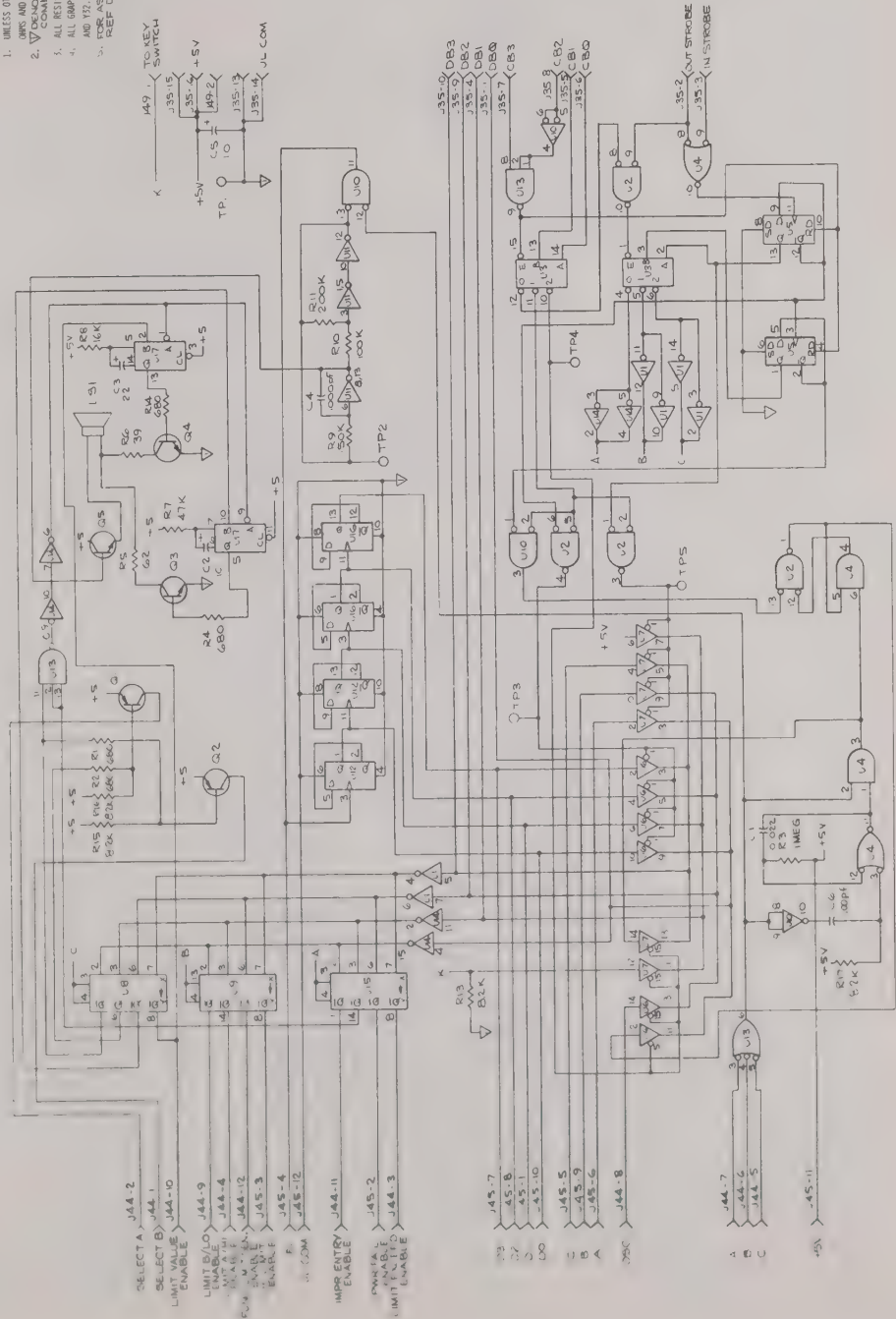


Figure 8-8. A9 Keyboard Logic PCB Assembly (2240A-1012) (Sheet 2 of 2)

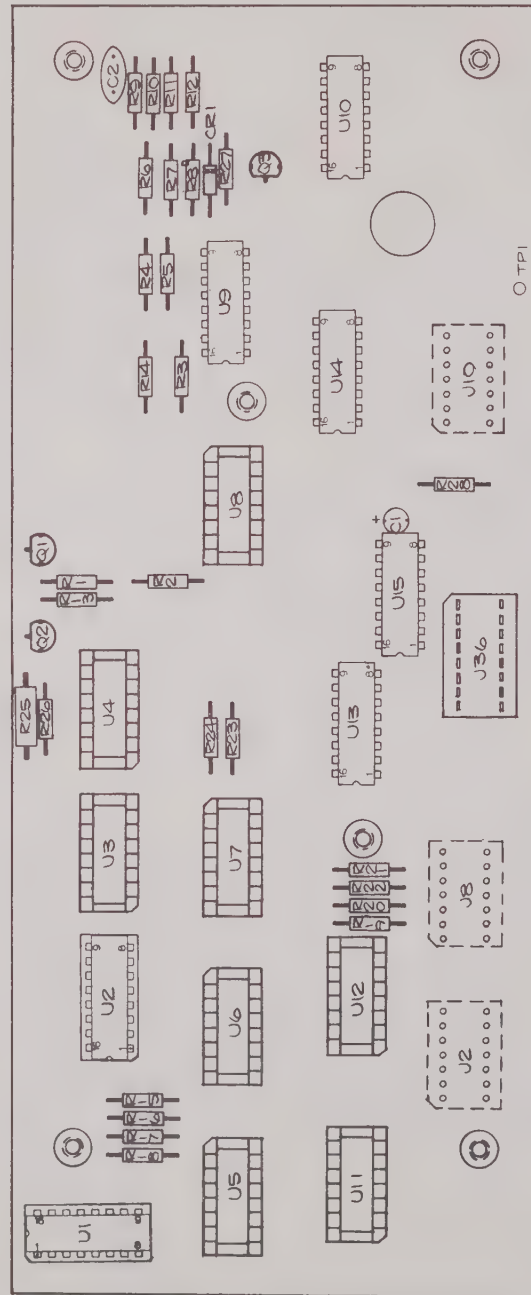
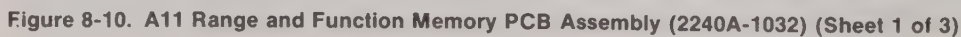


Figure 8-9. A10 Keyboard Memory PCB Assembly (2240A-1013) (Sheet 1 of 2)



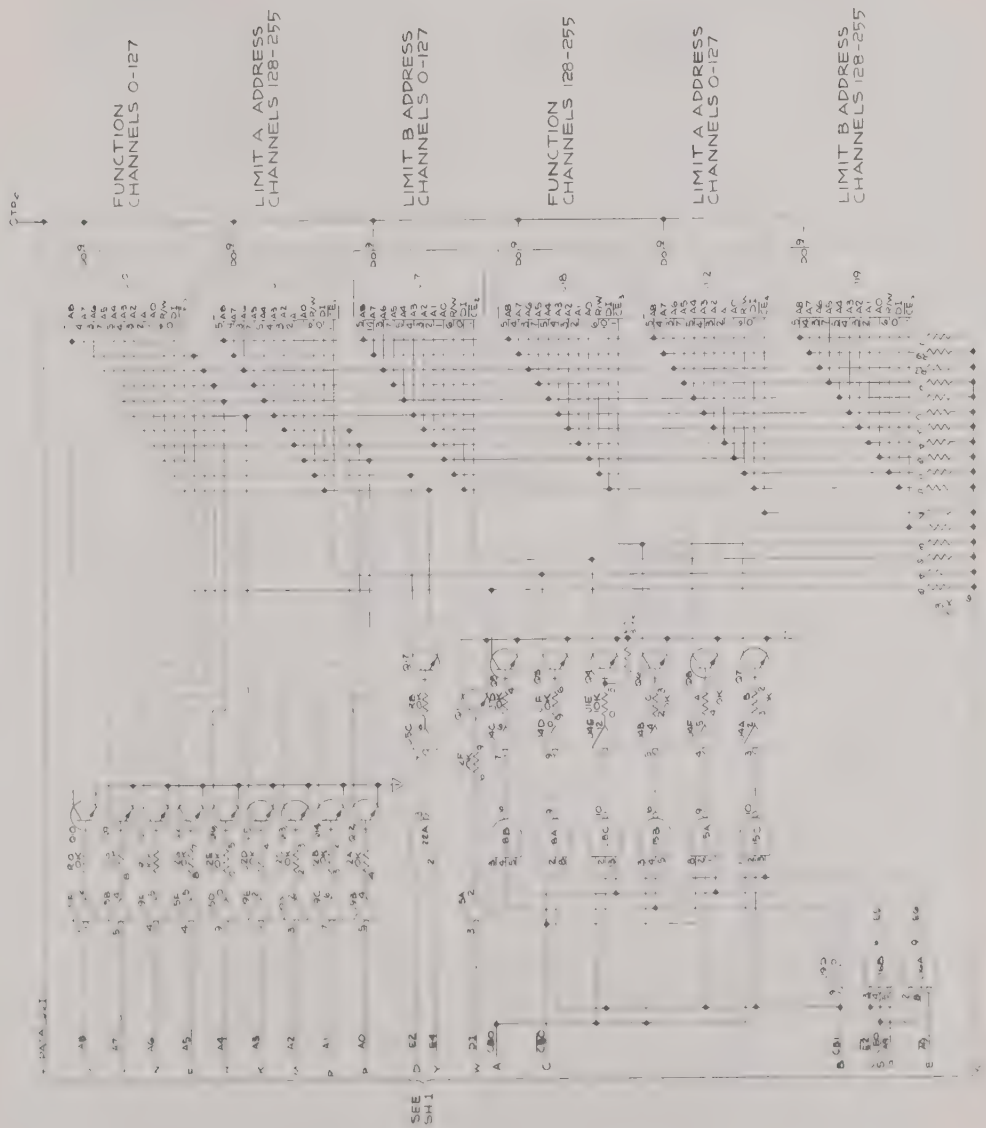


Figure 8-10. A11 Range and Function Memory PCB Assembly (2240A-1032) (Sheet 2 of 3)

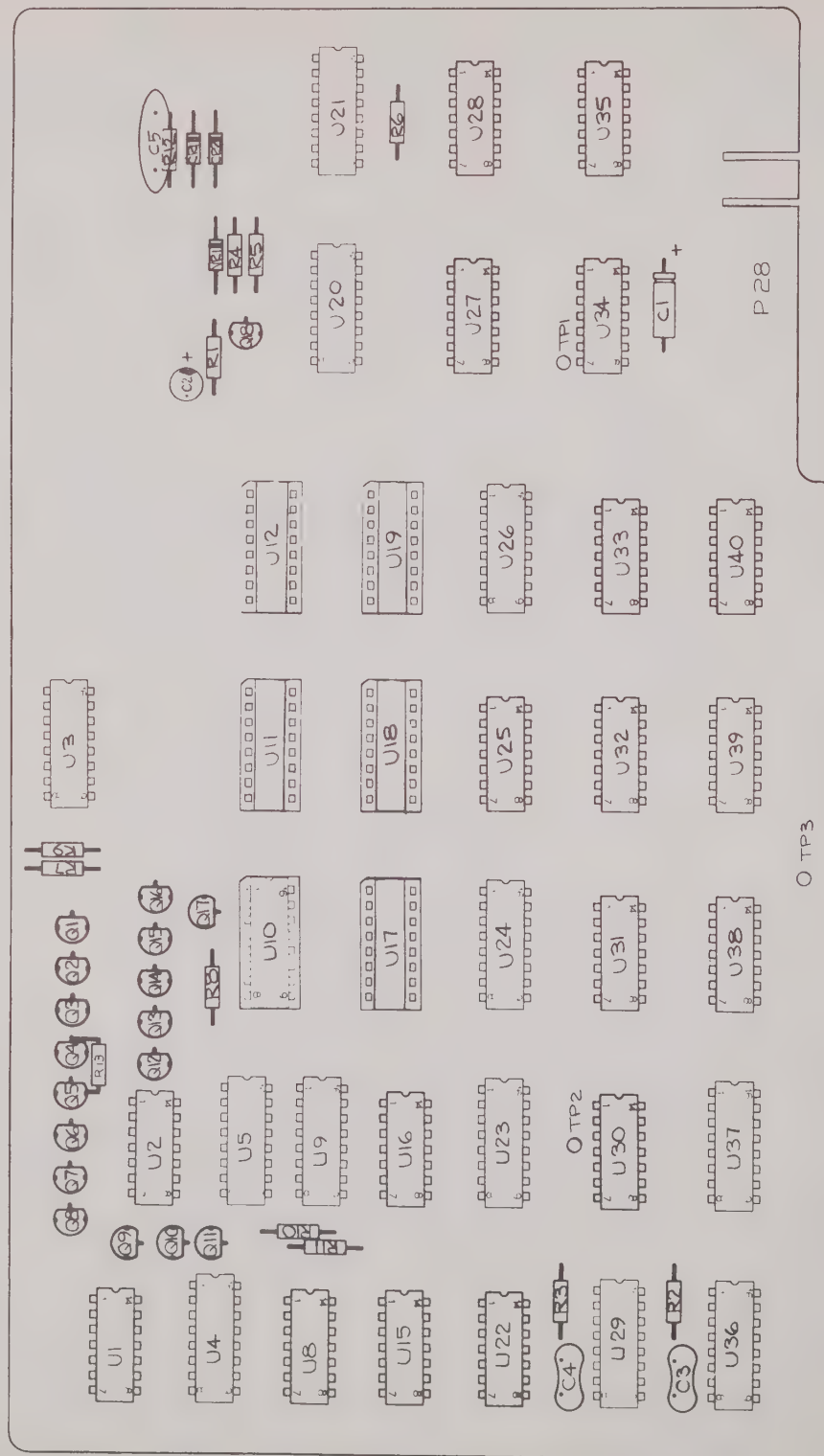


Figure 8-10. A11 Range and Function Memory PCB Assembly (2240A-1032) (Sheet 3 of 3)

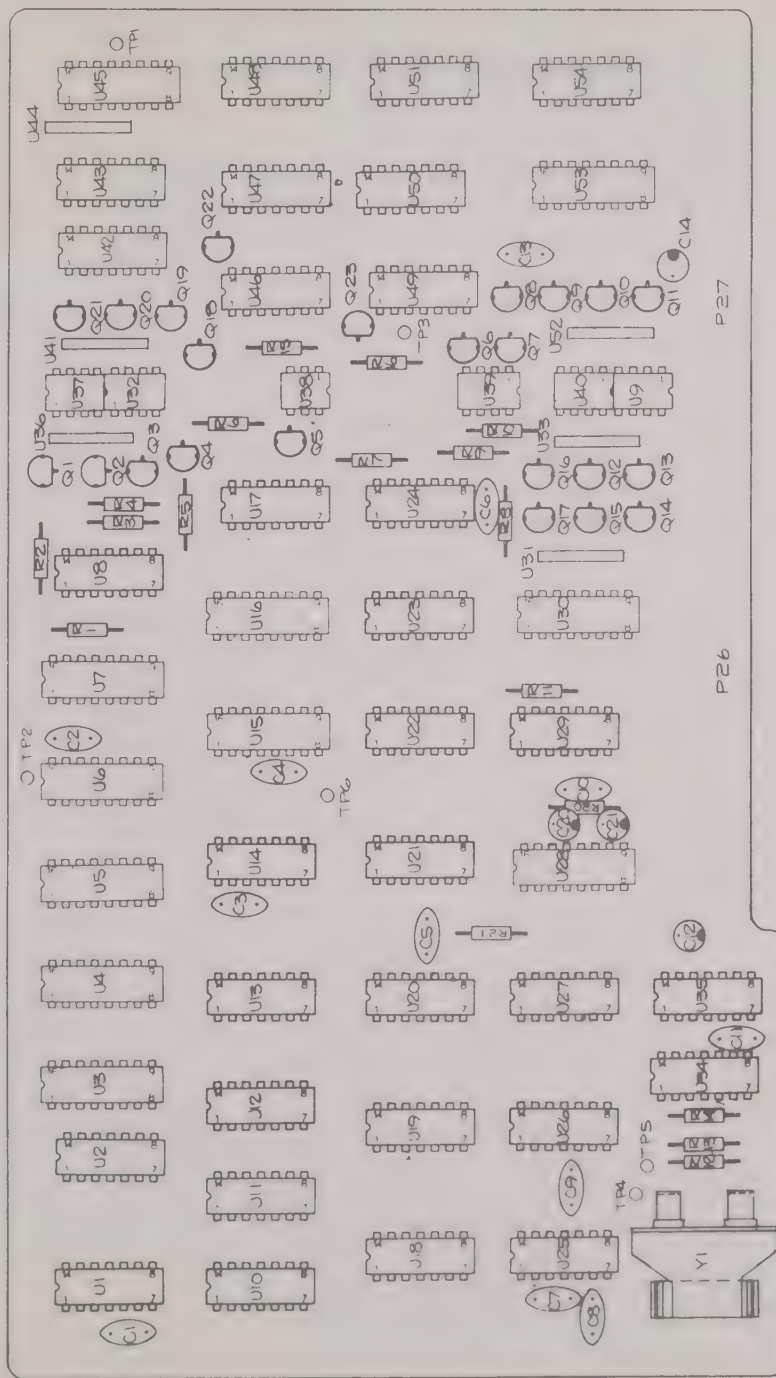


Figure 8-11. A4 Guard Crossing PCB Assembly (2200A-1004) (Sheet 1 of 3)

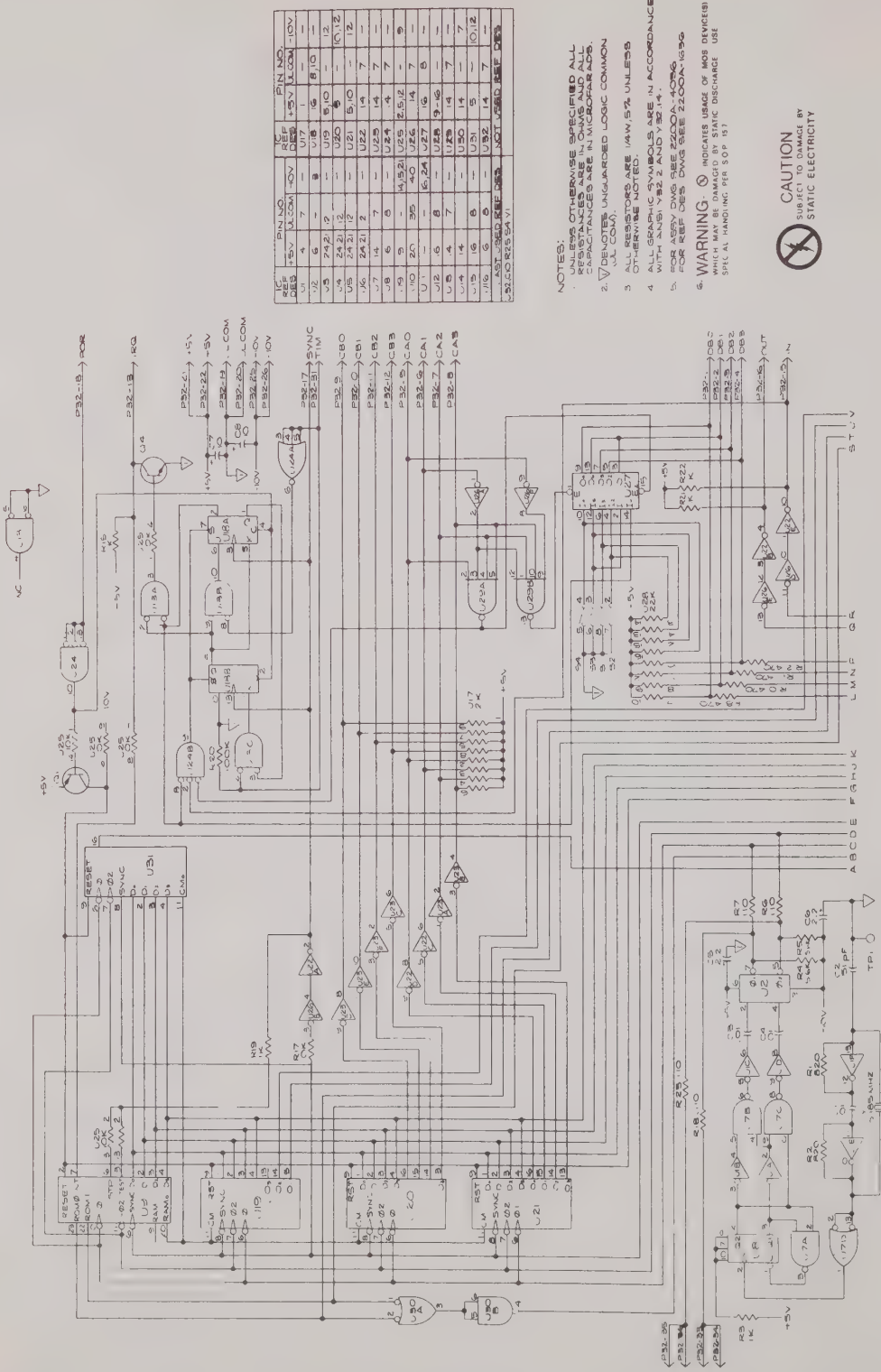


Figure 8-12. A3 Controller PCB Assembly (2200A-1036) (Sheet 1 of 3)

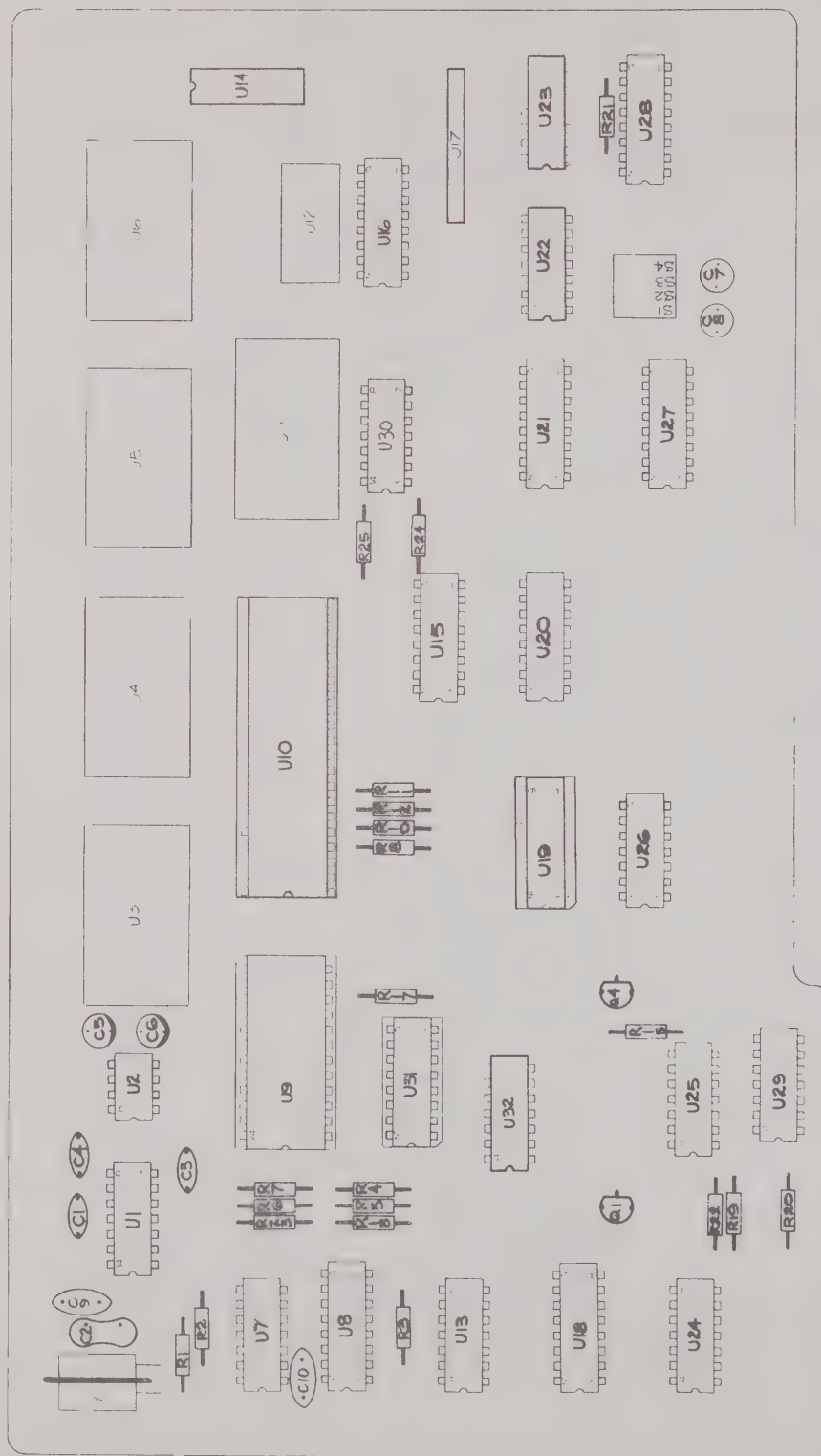


Figure 8-12. A3 Controller PCB Assembly (2200A-1036) (Sheet 3 of 3)

A0-A7	Address Bus	INT ACK	Interrupt Acknowledge
B0-B3	Output Data Bus	INT+D1	See Table 609-1 or 610-1
BAT	Battery	KBD MEM	Keyboard Memory
BI	Blanking input	MUX	Multiplexer
BS1-BS5,(BSX)	Block Select	N/C	No connection
CA0-CA3	Control Bus A	O1-O8	Output Bus
CB0-CB3	Control Bus B	OPENTC	Open thermocouple
CE0	Chip enable	OSC	Oscillator
CHS ₀ -CHS ₃	External Channel Select (Units)	PM	Program Memory
CS ₀ -CS ₃	Channel Select	POL	Polarity
CM	Chip enable	POR	Power on reset
D0-D3	Data Bus	REFCOMMON	Reference Common
DB0-DB3	Data Bus (I/O)	RET	Return
DE+Δ0	See Table 609-1 or 610-1	RJ	Reference junction
DISS	See Table 609-1 or 610-1	S1-S4	Strobe In
D01-D07	Data Output Port	SEN	Sense
DS0-DS3	External Channel Select (tens)	SIP	Scan in progress
E1-E4	Enable	STOP ACK	Stop Acknowledge
EIA	Electronic Industries Association	SYNC	Synchronization signal
EN	Enable	TIM	Time interval Marker
EOR	End of record	TL-TP	Printer timing pulses
GLCOMMON	Guarded Common	T	Temperature
HS0-HS3	External Channel Select (hundreds)	TEMP SIG	Temperature Signal
IRQ	Interrupt request	ULCOMMON	Unguarded Common
IAK	Interrupt Acknowledge	Δ0,Δ1,Δ2	See Table 609-1 or 610-1
INT	Integrate	01-02	Non overlapping clock signals

Figure 8-13. 2240B Mnemonics



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View Binder

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